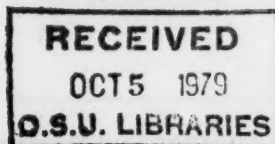


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SELECTED **WATER RESOURCES ABSTRACTS**

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VOLUME 12, NUMBER 16
AUGUST 15, 1979

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SELECTED WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Research and Technology,
U.S. Department of the Interior



VOLUME 12, NUMBER 16
AUGUST 15, 1979

W79-07501 -- W79-08000

The Secretary of the U.S. Department of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

ment. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

SELECTED WATER RESOURCES

ABSTRACTS

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.



U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
AUGUST 12 1978

WATER RESOURCES

Abstracts of the U.S. Department of the Interior, Bureau of Land Management, Water Resources Division, August 12, 1978. This publication is a compilation of abstracts of the U.S. Department of the Interior, Bureau of Land Management, Water Resources Division, August 12, 1978. It contains abstracts of the U.S. Department of the Interior, Bureau of Land Management, Water Resources Division, August 12, 1978.

U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT, WATER RESOURCES DIVISION, AUGUST 12, 1978. This publication is a compilation of abstracts of the U.S. Department of the Interior, Bureau of Land Management, Water Resources Division, August 12, 1978. It contains abstracts of the U.S. Department of the Interior, Bureau of Land Management, Water Resources Division, August 12, 1978.

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FOREWORD

Selecting Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus**. Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selecting Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstract-

ing, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency. A directory of the Centers appears on the inside back cover.

Supplementary documentation is being secured from established discipline-oriented abstracting and indexing services. Currently an arrangement is in effect whereby the Bio-Science Information Service of Biological Abstracts supplies WRSIC with relevant references from the several subject areas of interest to our users. In addition to Biological Abstracts, references are acquired from Bioresearch Index which are without abstracts and therefore also appear abstractless in SWRA. Similar arrangements with other producers of abstracts are contemplated as planned augmentation of the information base.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center
Office of Water Research and Technology
U.S. Department of the Interior
Washington, DC 20240

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Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

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ABSTRACT SOURCES

1. NATURE

1A. Properties

A STATISTICAL
WATER QUALITY
Geological
Div.
J. M. Land
Water Resour
468, April 1978

Descriptive
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J. C. Rosen
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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

A STATISTICAL VIEW OF A CLASS OF WATER QUALITY INDICES

Geological Survey, Reston, VA. Water Resources Div.
J. M. Landwehr.
Water Resources Research, Vol. 15, No. 2, p 460-468, April 1979. 10 fig, 2 tab, 26 ref.

Descriptors: *Water quality, *Indexing, *Statistical methods, Methodology, Water types, Water chemistry, *Water quality indices.

Water quality indices are treated as random variables; the class of quality 'averaging' indices is examined and several statistics are derived. The probability density functions of the water quality constituents and the structure of the transform functions (rating curves) influence the ability of indices to measure policy performance. (Woodard-USGS)

W79-07708

THE DEPENDENCE OF DEWATERING PROCESS ON AQUEOUS PROPERTIES OF SLUDGES

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Hidro-geologii, Gostroy (USSR).
L. G. Pirogov.

In: Handling, Treatment and Disposal of Wastewater Sludge, p 144-147, 1975. 6 tab.

Descriptors: *Dewatering, *Equations, *Sludge, *Physical properties, Osmosis, Filtration.

An investigation of the dependence of dewatering on the aqueous properties of sludges was carried out using the works of P. A. Rebinder, A. V. Likov, and M. P. Kazansky. Osmotically combined water was separated into two types: osmotic proper and entrapped water. When entrapped water is included in the Rebinder classification category, a uniform method for the calculation of physical constants related to water balance, structural and filtration characteristics, and sludge thickening, was developed. Equations and actual calculated values are presented for these physical characteristics. (See also W79-07825) (Small-FRC)

W79-07841

SPRINGS OF FLORIDA

Geological Survey, Tallahassee, FL. Water Resources Div.; and Florida Bureau of Geology, Tallahassee.

J. C. Roseman, G. L. Faulkner, C. W. Hendry, Jr., and R. W. Hull.
Florida Bureau of Geology Bulletin No 31 (revised), 1977. 461 p, 31 fig, 7 tab, 91 ref.

Descriptors: *Florida, *Springs, *Discharge(Water), *Spring waters, *Water quality, Artesian wells, Water utilization, Recreation, Scuba diving, Aquifer characteristics, Hot springs, Thermal water, Geohydrologic units, Karst, Caves, Submarine springs, Limestones, Aerial photography, Data storage and retrieval, *Springs inventory.

Florida's 27 first magnitude springs discharge more than 6 billion gallons per day from Tertiary limestone of the Floridan aquifer. Based on an inventory of about 300 springs, estimated total ground water discharge from Florida's springs averages 8 billion gallons per day, or more than twice the amount of fresh ground water pumped in Florida in 1975. The major use of the springs is recreational. Neither use nor spring flow has changed significantly in the past 30 years. A few springs in the populous southern part of the State no longer flow, or their flows have been reduced, owing to increased water use. Florida's springs are concentrated along the major streams and west coast. There are many submarine and some pseudosprings. At least 50 springs are known along the Suwannee

River and its tributaries, of which 9 are first magnitude springs having average flows of more than 65 million gallons per day. The report describes the springs, their water quality, and flow rates. Photographs and maps are included and each spring is located geographically and by latitude and longitude. (Woodard-USGS)

W79-07946

2. WATER CYCLE

2A. General

CHEMICAL CHARACTERISTICS OF SMALL STREAMS NEAR HANEY IN SOUTHWESTERN BRITISH COLUMBIA

British Columbia Univ., Vancouver. Faculty of Forestry.

For primary bibliographic entry see Field 2K.
W79-07540

EVOLUTION AND TESTING OF A FIVE-DAY WATER YIELD MODEL

Clemson Univ., SC. Dept. of Agricultural Engineering.

T. V. Wilson, J. T. Ligon, and A. G. Law.
Transactions of the American Society of Agricultural Engineers, Vol. 22, No. 2, p 298-303, March-April 1979. 11 fig, 4 tab, 5 ref.

Descriptors: *Water yield, *Watersheds(Basins), *Model studies, *Mathematical models, Runoff, Precipitation(Atmospheric), Rainfall-runoff relationships, Hydrographs, Flow, Analytical techniques, Hydrology, Parameters.

The water yield model developed at the Southeast Watershed Laboratory was used on 10 watersheds representing 3 physiographic provinces in an effort to test its adaptability to different watershed characteristics. In each case, the analysis mode was used to obtain optimized values for the 11 parameters using 5-day values of precipitation and runoff. For one watershed, each parameter (a group of 5 in one case) was varied individually through a range of 1/4 to 4 times its converged value to study the influence of single parameter variation. This process indicated that 1/2 to 2 times the converged parameters do not drastically alter the results of prediction. Some attempts were made to determine parameter differences on watersheds of different physiographic regions, but an insufficient number of watersheds was used to effectively relate physical watershed characteristics with parameters. Water yield predictions using converged parameters and averaged parameters (across 12 four-year watershed-periods) were made, plotted, and compared. Simulation results were good with converged parameters; peaks, recessions, low flows, and total yields matched well. With averaged parameters, total 4-year yields ranged from 69.6 to 127.8% observed flow. Peaks, recessions, and low flow were not as well matched, although qualitatively the shape of the hydrograph was well reproduced. (Sims-ISWS)

W79-07556

SIMULATION OF ARID RANGELAND WATERSHED HYDROLOGY WITH THE USDAHL-74 MODEL

Science and Education Administration, Boise, ID. Northwest Watershed Center.

C. L. Hanson.
Transactions of the American Society of Agricultural Engineers, Vol. 22, No. 2, p 304-309, March-April 1979. 7 fig, 4 tab, 9 ref.

Descriptors: *Soil water, *Runoff, *Model studies, *Mathematical models, *Idaho, Ranges, Arid lands, Arid climates, Precipitation(Atmospheric), Rainfall, Snowfall, Snowmelt, Infiltration, Soils, Geology, Land use, Grazing, Vegetation, Watersheds(Basins), Hydrology.

The USDAHL-74 revised model of watershed hydrology was evaluated on an 83-ha arid rangeland watershed in southwest Idaho. The model simulated soil water adequately, except during periods in late summer and fall. Simulated runoff indicated

that the model responded primarily to precipitation intensity; however, measured watershed runoff responded primarily to precipitation amount and not as much to intensity. (Sims-ISWS)

W79-07557

HYDROLOGIC EFFECTS OF BRUSH CONTROL ON TEXAS RANGELANDS

Science and Education Administration, Temple, TX.

C. W. Richardson, E. Burnett, and R. W. Bovey.
Transactions of the American Society of Agricultural Engineers, Vol. 22, No. 2, p 315-319, March-April 1979. 3 fig, 3 tab, 8 ref.

Descriptors: *Brush control, *Vegetation effects, *Runoff, *Texas, *Southwest U.S., On-site investigations, Ranges, Mesquite, Rainfall, Drainage, Effects, Soil moisture, Soil water, Watersheds(Basins), Evapotranspiration, Vegetation, Herbicides, Hydrology.

Noneconomic brushy vegetation infests millions of acres of rangeland in the Southwestern United States. This investigation was conducted to determine the hydrologic effects of controlling the brush chemically or mechanically. In the Blackland Prairie of Texas, two small watersheds infested with honey mesquite were selected for this study. The mesquite on one watershed was killed with chemicals. Killing the mesquite reduced evapotranspiration about 8 cm per yr and increased surface runoff about 10%. In the Edwards Plateau of Texas, two watersheds infested with brush were used to determine the hydrologic effects of mechanical methods of brush control. Root plowing to remove the brush on one watershed reduced surface runoff about 20%. (Sims-ISWS)

W79-07558

'ARIMA' PROCESSES FOR HYDROMETEOROLOGICAL FORECASTING AND SIMULATION (LES PROCESSUS DU TYPE 'ARIMA' POUR LA PREVISION ET LA SIMULATION EN HYDROMETEOROLOGIE)

Purdue Univ., Lafayette, IN. Water Resources Research Center.
J. W. Delleur.
La Houille Blanche No. 6, p 391-400, 1978. 7 fig, 2 tab, 16 ref. (English summary). OWRT B-036-IND (19).

Descriptors: *Weather forecasting, *Runoff forecasting, *Stochastic processes, Simulation analysis, Synthetic hydrology, ARIMA, Hydrometeorology.

'ARIMA' stochastic process models are combinations of autoregressive models and movable averages over random independent variables. Their flexibility allows simulation of the random structures of stationary or non-stationary chronological hydrometeorology records. Their application is facilitated by routine model identification, estimation and test methods. Applications of 'ARIMA' models for description of monthly rainfall and both monthly and annual runoff in a certain number of catchments in the central United States are discussed. An example is given of the use of such models for forecasting runoff from forecast rainfall data.

W79-07583

EFFECTS OF A BARRIER ON TEMPERATURE STRUCTURE AND MIXING IN THERMALLY STRATIFIED WATER COOLED FROM ABOVE

Purdue Univ., Lafayette, IN. School of Mechanical Engineering.
R. Viskanta, A. Karalis, and M. Behnia.
Warme- und Stoffübertragung, Vol. 11, p 229-239, 1978. 8 fig, 1 tab, 18 ref. OWRT B-077-IND(3).

Descriptors: *Heat transfer, *Convection, *Cooling, *Stratification, Heat flow, Energy transfer, Temperature, Thermocline, Interferometry, Mach-Zehnder Interferometer.

A Mach-Zehnder interferometer was used to study the unsteady temperature structure in radiation

Field 2—WATER CYCLE

Group 2A—General

stratified water cooled from above. Temperature distribution measurements in a test cell filled with distilled water provide conclusive evidence that the thermal structure between the air-water interface and the stable region is controlled by buoyancy induced natural convection. The cooling from above produces a complex vertical temperature profile which can be divided into several distinct regimes. Introduction of a thin, rigid transparent (glass) plate into the water before thermal stratification by radiation and cooling confines the natural convection driven flow and reduces the intensity of mixing. As a result, the energy transport from the interior of the water layer to the interface is decreased. However, under the experimental conditions tested use of rigid, horizontal plates introduced in the fluid was not very effective in reducing the transport of heat from the warm interior to the cooler interface.

W79-07584

FREE CONVECTION IN THERMALLY STRATIFIED WATER COOLED FROM ABOVE

Purdue Univ., Lafayette, IN. School of Mechanical Engineering.

M. Behnia, and R. Viskanta.

International Journal of Heat Mass Transfer. Vol. 22, p 611-623, 1979. 11 fig, 1 tab, 30 ref. OWRT B-077-IND(4).

Descriptors: *Heat transfer, *Convection, *Cooling, *Stratification, Heat flow, Energy transfer, Temperature, Thermocline, Interferometry, Mach-Zehnder Interferometer.

The thermal and fluid kinetics of the convective layer during cooling from the free surface of a thermally stratified water by convection, latent energy transport, and radiation is studied. Laboratory experiments were performed and a Mach-Zehnder interferometer was used to measure the unsteady temperature distribution in a test cell filled with water which was previously stratified. A simple mathematical model based on a thermal energy balance is developed to predict the thickness and the mean temperature of the layer. The model predictions agreed to within 10% with the data from controlled laboratory experiments. It was found that the numerical solution to the model equations agree better with the experimental data than those based on the closed form analytical solution using the constant average surface heat flux. It was determined that the surface boundary condition and the internal physical processes of mixing and entrainment must be better understood in order to model the dynamics of the mixed layer in natural waterbodies.

W79-07585

A GEOHYDROLOGIC OVERVIEW FOR THE PECORA SYMPOSIUM FIELD TRIP, JUNE 1979

Geological Survey, Huron, SD. Water Resources Div.

N. C. Koch.

Geological Survey open-file report 79-563, May 1979. 19 p, 3 fig, 6 ref.

Descriptors: *Available water, *Surface waters, *Groundwater resources, *Hydrogeology, *South Dakota, Aquifer characteristics, Water wells, Water yield, Streamflow, Precipitation(Atmospheric), Lakes, *Big Sioux River basin(S Dak).

The settlement and development of South Dakota and the Big Sioux River basin have been closely related to water resources. The climate is a continental type and annual precipitation in the basin is about 23 inches. The area of the field trip lies within the Coteau des Prairies, a massive highland within the Central Lowlands Province. It is drained primarily by the Big Sioux River. The bedrock underlying the coteau is a series of Cretaceous sedimentary rocks and the Sioux Quartzite of Precambrian age. Wells in the Cretaceous Dakota Sandstone yield from 10 to 1,000 gallons per minute; the other bedrock formations generally yield less than 10 gallons per minute. The glacial outwash deposits on the coteau are generally ex-

cellent sources of ground water; the other glacial deposits, till and loess, are not dependable sources. (Woodard-USGS) W79-07699

A PHYSICALLY BASED, VARIABLE CONTRIBUTING AREA MODEL OF BASIN HYDROLOGY

Institute of Hydrology, Wallingford (England).

K. J. Beven, and M. J. Kirkby.

Hydrological Sciences Bulletin, Vol. 24, No. 1, p 43-69, March 1979. 16 fig, 1 tab, 36 ref.

Descriptors: *Watersheds(Basins), *Hydrology, *Model studies, *Hydrological aspects, Analytical techniques, Hydrologic properties, Areal, Infiltration, Mathematical models, Soil moisture, Saturated soils, Routing, Channels, Spatial distribution, Overland flow, Calibrations, Interception, Foreign research, On-site tests, Runoff, *Great Britain, Sub-basin model.

A hydrological forecasting model was presented that attempts to combine the important distributed effects of channel network topology and dynamic contributing areas with the advantages of simple lumped parameter basin models. Quick response flow is predicted from a storage/contributing area relationship derived analytically from the topographic structure of a unit within a basin. Average soil water response was represented by a constant leakage infiltration store and an exponential subsurface water store. A simple, non-linear routing procedure related to the link frequency distribution of the channel network completes the model and allows distinct basin sub-units, such as headwater and sideslope areas to be modelled separately. The model parameters are physically based in the sense that they may be determined directly by measurement and the model may be used at ungauged sites. Procedures for applying the model and tests with data from the Crimple Beck basin were described. Using only measured and estimated parameter values, without optimization, the model makes satisfactory predictions of basin response. The modular form of the model structure should allow application over a range of small and medium sized basins while retaining the possibility of including more complex model components when suitable data are available. (Humphreys-ISWS) W79-07753

EFFECTS OF CHANNEL ENLARGEMENT BY RIVER ICE PROCESSES ON BANKFULL DISCHARGE IN ALBERTA, CANADA

Calgary Univ. (Alberta). Dept. of Geography.

For primary bibliographic entry see Field 2E.

W79-07756

ON THE INFLUENCE OF THE SPATIAL DISTRIBUTION OF RAINFALL ON STORM RUNOFF

Corps of Engineers, Washington, DC.

For primary bibliographic entry see Field 2B.

W79-07765

THE ZOOGEOGRAPHY OF THE FRESHWATER FISHES OF THE POTOMAC RIVER BASIN

Maryland Univ., Frostburg. Appalachian Environmental Lab.

J. R. Stauffer, Jr., C. H. Hocutt, and D. S. Lee.

Interstate Commission on the Potomac River Basin, Rockville MD. Technical Publication 78-2.

In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. D. and Mason, W. T., Eds., 1978. p 44-54, 2 fig, 61 ref.

Descriptors: *Freshwater fish, *Fish migration, *Fish populations, *Fish establishment, *Geologic history, *Potomac River, River systems, Drainage patterns(Geologic), Watersheds(Divides).

The Potomac River is part of a transition area between the northern Atlantic slope drainages, characterized by few native species and endemics, and the more rich southern Atlantic slope drain-

ages. Presently 78 species and one endemic are known from the Potomac. The Potomac is the northern range limit for *Phoxinus* areas, *Nocomis leptocephalus*, and *Moxostoma rathocum*, and the southern limit for *Notropis* a. *spilopterus*, *Pimephales notatus*, *Semotilus m. marginata*, *Percopsis omiscomaycus*, and *Percina caprodes*. *Etheostoma caeruleum* is known only to the Potomac on the Atlantic slope. Northern forms of Potomac fauna entered through stream captures with the Susquehanna River, but because of the similarity of the fauna of both basins, no specific cases are documented. Ohio River fishes most likely entered through captures with the Monongahela River basin. An exchange between the Potomac and Roanoke-Teays system through the James is indicated by the presence of *Moxostoma rathocum*. The Atlantic coastal plain endemics found in the Potomac most likely dispersed into and from the Potomac through the prevalent, low-lying, interconnecting streams and ditches. The species introduced into the Potomac have been subdivided into Old World species and transplants, which are those native to North America. Three species are no longer found in the Potomac and one, *Acipenser brevirostrum*, is on the Federal threatened and endangered list. (Davison-IPA) W79-07968

FISHERY RESOURCES AND MANAGEMENT IN WEST VIRGINIA

West Virginia Dept. of Natural Resources, Romney.

G. E. Lewis.

Interstate Commission on the Potomac River Basin, Rockville, MD. Technical Publication 78-2.

In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. D. and Mason, W. T., Eds., 1978. p 55-58, 2 tab, 9 ref.

Descriptors: *Fish, *Fishing, *Fish populations, *Fish establishment, *Aquatic environment, *Aquatic habitats, Sport fish, River systems, Drainage systems, River basins, Watersheds(Basins), Interstate rivers, Potomac River, West Virginia, Creel census.

Nearly half of the cold-water and warm-water fishery resources in West Virginia are in the Potomac River drainage where most of the game fish have been introduced. The three largest streams within the Potomac basin of West Virginia are the Shenandoah, South Branch, and Cacapon Rivers. A shift in the Shenandoah towards species favoring eutrophic situation is attributed to the high levels of nitrogen and phosphorus compounds in waste water from cities, land surface runoff, and organic humus. Fishing is good to excellent for smallmouth bass and sunfish in the Cacapon and South Branch rivers. The West Virginia Department of Natural Resources is currently acquiring strategically located sites to facilitate access to the larger streams of the Potomac basin. Stream sediment, particularly heavy in areas being urbanized, has become a source of fish habitat degradation. A demonstration project in stream bank stabilization undertaken by the Fisheries Section of the Division of Wildlife to combat sediment transport has shown encouraging results. The diversity of physiographic features of some of the streams of the Potomac drainage in West Virginia made them potential additions to the National Wild and Scenic Rivers system. (Davison-IPA) W79-07969

REDUCING THE COST OF CONTINUOUS HYDROLOGIC-HYDRAULIC SIMULATION

Donohue and Associates, Inc., Waukesha, WI.

S. G. Walesh, and D. F. Snyder.

Water Resources Bulletin, Vol. 15, No. 3, p 644-659, June 1979. 5 fig, 3 tab, 11 ref.

Descriptors: *Computers, *Simulation analysis, *Continuous models, *Water quality, *Hydrology, *Hydraulics, *FRIT technique, Watersheds(Basins), Wisconsin, Meteorology, Cost reductions, Flood water storage, Land use changes, Channel modification, Discrete events, Discharge-frequency relations, Effects, Probability, Systems analysis.

Snow, Ice, and Frost—Group 2C

tion which did not consider storm type. Predictions of storm amounts were closest to measured amounts for storms where the low-pressure center passed east of Coweeta, while the predictions for the air-mass or thunderstorm type had the greatest errors. The prediction errors of the equations for warm-, cold-, and stationary-front storm types were intermediate. The small number of tropical storms limited development and testing of equations for that type. (Sims-ISWS)
W79-07767

2C. Snow, Ice, and Frost

THE APPLICATION OF AERIAL AND SATELLITE SNOW-MAPPING TECHNIQUES FOR MULTI-PURPOSE RESERVOIR SYSTEM OPERATIONS IN ARIZONA,
Salt River Project, Phoenix, AZ; and Geological Survey, Phoenix, AZ. Water Resources Div. For primary bibliographic entry see Field 7B.
W79-07695

PERIODIC SURGING OF THE ANTARCTIC ICE SHEET—AN ASSESSMENT BY MODELING,
Melbourne Univ., Parkville (Australia). Antarctic Div.
W. F. Budd, and B. J. McInnes.
Hydrological Sciences Bulletin, Vol. 24, No. 1, p 95-104, March 1979. 7 fig, 2 tab, 16 ref.

Descriptors: *Ice, *Surges, *Model studies, *Antarctic, Movement, Glaciers, On-site investigations, Velocity, On-site data collections, Physical properties.

A numerical model has been developed which simulates surging in certain glaciers and ice sheets in an apparently realistic manner. This model has been found to give small mountain glaciers to large sectors of ice caps. The model reproduces realistically many features of these ice masses such as the period of the surge, the duration, the velocity of advance, the magnitude of the advance, and the changes in ice thickness. The application of the model to the Antarctic ice sheet is made more difficult by the problem caused by the temperature dependence of the flow properties of ice. This means that for a complete study the interaction with the environment needs to be considered. However, at this stage preliminary calculations indicate a number of features that are relevant to the effect of Antarctic ice surges on the global climate. These include the period between surges, the duration of the surge, the amount of ice advanced and the changes in thickness of the ice sheet. (See also W75-03085 and W75-08713) (Humphreys-ISWS)
W79-07751

EFFECT OF SURFACE MELTWATER ACCUMULATION ON THE DISSIPATION OF LAKE ICE,
Delaware Univ., Newark. Dept. of Civil Engineering.
A. Wake, and R. R. Rumer.
Water Resources Research, Vol. 15, No. 2, p 430-434, April 1979. 8 fig, 2 tab, 13 ref. NOAA 03-6-022-352636.

Descriptors: *Lake ice, *Melting, *Boundary processes, *Model studies, Melt water, Ice, Air-water interfaces, Mathematical models, Heat balance, Albedo, Heat transfer, Analytical techniques, Solar radiation, Air-ice interface.

The rate of ice melt with and without water accumulation on the ice surface was computed based on the interfacial heat exchange processes, the thermal diffusion of heat through the accumulated water, and the internal absorption of solar radiation. Although the accumulated water does increase the net absorbed solar radiation due to reduced albedo, the resulting air-water interface temperature was found to be considerably greater than 0°C, thereby decreasing the net long-wave, sensible, and evaporative heat inputs. The findings indicated that the overall effect of accumulated water on ice melt

The use of continuous hydrologic-hydraulic-water quality models is inhibited by their large computer run costs relative to cost incurred with discrete event models. The fixed recurrence interval transfer (FRIT) technique is a means of achieving substantial reductions in computer costs associated with continuous models while retaining their technical advantages. The FRIT technique is applicable where it is reasonable to assume that the recurrence interval of the response of a watershed to a causative meteorologic event is the same for both 'before' and 'after' conditions. Example applications of FRIT to the hydrologic-hydraulic modeling of floodwater storage, land use changes, and channel modifications are presented to demonstrate the procedure, to suggest the expected accuracy, and to illustrate how computer run costs might be reduced by 99% or more. The FRIT technique is intended for preliminary assessment of the impact of alternative land use conditions and structural water control measures. (Bell-Graf-Cornell)
W79-07998

2B. Precipitation

ANNUAL PRECIPITATION IN THE NORTH-EAST UNITED STATES: LONG MEMORY, SHORT MEMORY, OR NO MEMORY,
Pennsylvania State Univ., University Park. Dept. of Geosciences.
K. W. Potter.
Water Resources Research, Vol. 15, No. 2, p 340-346, April 1979. 3 fig, 4 tab, 23 ref.

Descriptors: *Precipitation(Atmospheric), *Climatology, *Statistics, *Northeast U.S., Climatic data, Analytical techniques, Data processing, Statistical methods, Homogeneity, Annual, Time series analysis, Correlation analysis, Rainfall, Snowfall, Streamflow, Meteorology, Autocorrelation analysis.

Regional filtering and intervention analysis of nineteen 100-year precipitation series from the northeast United States indicated that 8 of these series are of doubtful homogeneity. Statistics of these series were generally distorted. Of particular significance is the inflation of the short-lag autocorrelation function and Hurst coefficient. For the precipitation series which appear to be homogeneous, the estimated autocorrelation functions and Hurst coefficients are remarkably consistent with a lag 1 autoregressive process, indicating that annual precipitation in the northeast United States is a short-memory process. Based on these results, it was recommended that before long-term memory is inferred from analyses of hydrologic series, the homogeneity of these series should be clearly established. (Sims-ISWS)
W79-07555

USE OF SPECIFIC CONDUCTANCE AND CONTACT TIME RELATIONS FOR SEPARATING FLOW COMPONENTS IN STORM RUNOFF,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. H. Pilgrim, D. D. Huff, and T. D. Steele.
Water Resources Research, Vol. 15, No. 2, p 329-339, April 1979. 7 fig, 23 ref.

Descriptors: *Storm runoff, *Base flow, *Dissolved solids, On-site investigations, Flow, Specific conductivity, Runoff, Soil water, Subsurface flow, Surface runoff, Soil water, Sampling, Data processing, Analytical techniques, Solids contact processes, Contact time.

The difference between the dissolved-solids concentrations in base flow and in storm flow has often been used as the basis for separating components of flow. However, an analysis that explicitly relates the amount of time that runoff water has been in contact with watershed soils to the resulting dissolved-solids concentration showed that simple mass balance chemistry methods for hydrograph separation are misleading. Field studies of surface and subsurface storm flow, when coupled with laboratory determination of the relationship

between contact time and dissolved solids content of a soil water mixture, suggested that the residence time of infiltrated water is as short as a few hours in the cases studied. In those cases, hydrograph separation methods based on the simple mass balance equation for the dissolved solids will yield considerable overestimates of the base flow component. (Sims-ISWS)
W79-07764

ON THE INFLUENCE OF THE SPATIAL DISTRIBUTION OF RAINFALL ON STORM RUNOFF,
Corps of Engineers, Washington, DC.
C. B. Wilson, J. B. Valdes, and I. Rodriguez-Irurbe.

Water Resources Research, Vol. 15, No. 2, p 321-328, April 1979. 6 fig, 2 tab, 8 ref. NWS 4-36738.

Descriptors: *Rainfall, *Runoff, *Storm runoff, *Model studies, Mathematical models, Spatial distribution, Isohyets, Mapping, Hydrographs, Discharge(Water), Streams, Rainfall-runoff relationships, Watersheds(Basins), Networks, Rain gages, Meteorology.

This study was an assessment of the importance of precipitation accuracy on the rainfall-runoff modeling of a small catchment. Two mathematical models were used in the investigation: a deterministic rainfall-runoff model based on the kinematic wave approximation and a nonstationary time-varying multi-dimensional rainfall generation model. It was implicitly assumed that this rainfall generation model is an appropriate mathematical representation of the natural phenomenon of rainfall. The deterministic rainfall-runoff model was used to represent the 26.5 sq mi catchment of the Rio Fajardo in northeastern Puerto Rico. The rainfall model generates synthetic rainfall which serves as the input to this runoff model. The influence of the spatial distribution of the rainfall input on the discharge was analyzed by using 1 rain gage or 20 rain gages to record the synthetic storms. The isohyetal maps and hyetographs of the synthetic storms, together with the storm hydrographs produced by the runoff model, were analyzed, with specific attention given to the volume of storm runoff, time-to-peak runoff, and peak runoff. The experiments showed that the spatial distribution of rain and the accuracy of the precipitation input have a marked influence on the outflow hydrograph from a small catchment. (Sims-ISWS)
W79-07765

AN INVESTIGATION INTO THE EFFECT OF STORM TYPE ON PRECIPITATION IN A SMALL MOUNTAIN WATERSHED,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
W. J. March, J. R. Wallace, and L. W. Swift, Jr.
Water Resources Research, Vol. 15, No. 2, p 298-304, April 1979. 1 fig, 6 tab, 18 ref.

Descriptors: *Precipitation(Atmospheric), *Rainfall, *Storms, *Model studies, *Appalachian Mountain region, Mathematical models, Evaluation, On-site data collections, Watersheds(Basins), Forest watersheds, Mountains, Mountain forests, Networks, Rain gages, Data processing, Meteorology.

A set of regression equations relating storm rainfall depth to watershed topography and storm type was derived for the high-density precipitation network at Coweeta Hydrologic Laboratory. The most general equation predicted storm amounts for an independent test group of gages with an average error of 0.38 cm (0.15 inches). The dependent variables was the ratio of the rainfall at each site to the rainfall at a base gage. Predictive variables were topographic slope, aspect, ground elevation at the gage site, and smoothed elevation. The smoothed elevation, which is the elevation the gage would assume if it were on a smooth plane representing the general topography of the terrain, appeared in more equations than any other variable. One equation was calculated for each of 6 identified storm types, and one equation was calculated with all storms considered together. Overall, the equations which considered storm type were not better predictors of site rainfall than the equa-

Field 2—WATER CYCLE

Group 2C—Snow, Ice, and Frost

may not be quite as large as expected from albedo differences alone. The often used bare ice assumption is still believed to serve as a good engineering approximation. More study is needed to relate the vertical thermal diffusivity to such factors as wind effects, gravitational stability, and water depth. Verification would be difficult in the field, but laboratory experimentation seems possible. (Humphreys-ISWS)
W79-07759

2D. Evaporation and Transpiration

EVAPOTRANSPIRATION COMPUTED TO ESTIMATE LEACHING FRACTIONS, Science and Education Administration, Grand Junction, CO.

D. C. Kincaid, E. G. Kruse, H. R. Duke, and D. F. Champion.
Transactions of The American Society of Agricultural Engineers, Vol. 22, No. 2, p 310-319, March-April 1979. 4 fig, 3 tab, 10 ref.

Descriptors: *Evapotranspiration, *Leaching, *Irrigation, *Colorado, Model studies, Simulation analysis, Reclamation, Soils, Winds, Dew point, Vapor pressure, Wind velocity, Equations, *Leaching fractions, *Potential evapotranspiration, *Grand Valley(CO), Soil heat flux, Saturation vapor pressure.

The United States Department of Agriculture Irrigation Scheduling Program with a Penman-type potential evapotranspiration equation was used as a simulation model to compute daily water use and deep percolation amounts on several sprinkler and furrow irrigated sites in the Grand Valley of Colorado. Input included daily weather data from one site and measured water applications on each site for the 1976 irrigation season. Leaching fractions of 0 to 0.1 were determined for a sprinkler irrigated field. For furrow irrigated sites, average seasonal leaching fractions of 0.28 and 0.51 were computed for the low and high intake rate soils, respectively. Furrow intake measurements and computed deep percolation amounts indicated that about 1/2 of the seasonal leaching occurred following the first irrigation. (Roberts-ISWS)
W79-07546

WIND PROFILE PARAMETERS AND TURBULENCE INTENSITY OVER SEVERAL ROUGHNESS ELEMENT GEOMETRIES, Science and Education Administration, Manhattan, KS.

L. Lyles, and B. E. Allison.
Transactions of the American Society of Agricultural Engineers, Vol. 22, No. 2, p 334-338, 343, March-April 1979. 3 fig, 4 tab, 15 ref.

Descriptors: *Winds, *Wind erosion, *Evaporation, *Soils, Soil water, Soil moisture, Particle size, Profiles, Wind velocity, Roughness coefficient, Turbulence, Velocity, Model studies, Mathematical models.

Estimating equations were developed for the mean velocity profile parameters in the logarithmic law and for longitudinal turbulence intensity. The estimates were based on wind tunnel measurements over several roughness element shapes, sizes, heights, and geometrical patterns. All the prediction equations had correlation coefficients greater than 0.90. These equations have application in wind erosion of soil particles, water evaporation, and transport of gases. They only apply to a particular set of conditions, which indicates a need for more universally applicable equations for the profile parameters and turbulence intensity. (Sims-ISWS)
W79-07547

AN ADVECTION-ARIDITY APPROACH TO ESTIMATE ACTUAL REGIONAL EVAPOTRANSPIRATION, Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.

W. Brutsaert, and H. Stricker.
Water Resources Research, Vol. 15, No. 2, p 443-

450, April 1979. 9 fig, 34 ref.

Descriptors: *Evapotranspiration, *Meteorological data, *Model studies, Advection, Evaporation, Atmosphere, Energy budget, Droughts, Watersheds(Basins), Soil moisture, Equations, Mathematical studies, Regions, Measurement, *Regional evapotranspiration, *Potential evaporation, Symmetry, Conceptual model, Regional advection, Evaporative power, Atmospheric conditions, Energy budget method, Severe drought.

Actual regional evapotranspiration was calculated by means of a procedure requiring only meteorological data, which are those data commonly used in the various versions of the combination approach for potential evaporation. The approach was based on a conceptual model involving, first, the effect of regional advection on potential evaporation, and second, an assumed symmetry between potential and actual evaporation with respect to the evaporative power of the air in the absence of advection. Thus, the degree of nonavailability of water for evapotranspiration, that is the aridity of the region, was deduced from the regional advection of drying power of the air, as implied by the atmospheric conditions. The approach was found to give good agreement with daily data of evapotranspiration obtained by means of an energy budget method for a period of severe drought in a rural watershed in a sandy region. One of the advantages is that no soil moisture data, no stomatal resistance properties of the vegetation, nor any other additional aridity parameters are required to determine actual evapotranspiration. (Roberts-ISWS)
W79-07548

POTENTIAL EVAPORATION—SIGNIFICANCE AND MEASUREMENT, Department of the Environment, Ottawa (Ontario). Hydrology Research Div.

F. I. Morton.
In: Hydrology Research Division, Annual Progress Reports and Short Research Notes, 1977-78, p 5-13, 1979. 5 fig, 1 tab, 9 ref. Environment Canada Inland Waters Directorate, Ottawa, Report Series No. 64. GW 68-8.

Descriptors: *Evapotranspiration, *Computer models, *Lakes, Climatic data, Computer programs, Temperature, Atmospheric pressure, Dew point, Climatology, Evaporation, Solar radiation.

The model described for estimating areal evapotranspiration is a modification of an earlier model, and provides estimates of lake evaporation from routine climatological observations in the land environment. Required input lake characteristics are latitude, altitude (or average atmospheric pressure), and an estimate of average annual precipitation. Require data inputs are monthly air temperatures, dew point temperatures, and the ratios of observed to maximum possible sunshine duration made in land or lake environments. The model, programmed in Fortran for the Hewlett-Packard 9100 A-9101 A desk calculator and the Hewlett-Packard pocket calculator, is designed for use anywhere in the world. The lake evaporation estimates, sensitive to errors in the sunshine duration inputs, are relatively insensitive to errors in the air temperature and dew point temperature inputs in comparison with areal evapotranspiration estimates. Seasonal changes in subsurface heat storage are not taken into account, and the model cannot provide realistic monthly evaporation estimates from deep lakes. Model estimates of annual lake evaporation are plotted against corresponding water budget estimates for Lake Hefner, Oklahoma; the Salton Sea and Silver Lake in California; Pyramid and Winnemucca Lakes in Nevada; Lake Ontario; and Dauphin Lake in Manitoba. Monthly average values for model estimates of evaporation and the water budget estimates are tabulated for Pyramid and Winnemucca Lakes. The maps provided show the average annual lake evaporation and the average annual or areal evapotranspiration in Canada and the United States. (Davison-IPA)
W79-07955

2E. Streamflow and Runoff

DRAINAGE EVOLUTION AND FISH DISPERSAL IN THE CENTRAL APPALACHIANS, SUMMARY, Maryland Univ., Frostburg, Appalachian Environmental Lab.

C. H. Hocutt.
Geological Society of America Bulletin, Part I, Vol. 90, p 129-130, February 1979. 1 fig, 4 ref.

Descriptors: *Fish migration, *Geologic history, *Pleistocene epoch, *Rivers, *Drainage, *Drainage effects, Aquatic habitats, Fish barriers, Drainage patterns(Geologic), Drainage systems, History.

Evidence indicates that the Appalachian Plateau once extended eastward to the present-day divide between the Greenbrier and James Rivers along Allegheny Mountain. During Pliocene time this extended plateau was drained by the Gauley River. Glacial ponding occurred in the Teays drainage during the Pleistocene, facilitating the dispersal of certain fish species and inhibiting the dispersal of others. Fish migrated up Teays River along the shoreline of glacial Lake Tight to negotiate the Kanawha Falls area. There, the fishes found the strenuous Gauley River river gorge less difficult than the evolving Teays-New River gorge. Concurrently, during the Pleistocene, Greenbrier River breached a major divide between it and Old Gauley, rapidly extending its drainage along a limestone belt. At this time faunal exchanges occurred along the Gauley-Greenbrier interface which may have facilitated the dispersal of Teays stock to the Atlantic slope through bypassing the Teays gorge. A map of the area is provided. (Davison-IPA)
W79-07510

L.N. FAN'S DATA ON BUOYANT JETS IN CROSSFLOW, McGill Univ. (Montreal). Dept. of Civil Engineering and Applied Mechanics.

For primary bibliographic entry see Field 8B.
W79-07536

OPTIMAL DESIGN OF CULVERTS UNDER UNCERTAINTIES, Texas Univ. at Austin. Dept. of Civil Engineering.

L. W. Mays.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY5, Proceedings Paper 14572, p 443-460, May 1979. 6 fig, 4 tab, 13 ref, 2 append. NSF ENG78-05449.

Descriptors: *Culverts, *Design, *Optimization, *Model studies, Mathematical models, Computer models, Probability, Statistics, Structures, Highways, Hydraulic structures, Flood damage, Risks, Water resources, Hydraulics, Hydrology, Civil engineering, Uncertainty principle, Optimal design.

In the design of highway drainage culverts there are many uncertainties involved in addition to the normally considered hydrologic uncertainty due to the randomness in flood and rainfall frequencies. Uncertainties can be contributed from many sources and are classified as hydrologic, hydraulic, structural, and economic with subtypes of uncertainties in each of these categories. This paper described a procedure for systematically analyzing and incorporating the uncertainties into the optimal design of drainage culverts. The procedure was based upon the concepts of hydrologic risk, first-order analysis of uncertainties, evaluation of expected damages, and optimization. The optimization model was used to select the magnitudes of the design variables in order to minimize total expected project costs. Using such a design procedure, the proper trade-off analysis among the potential flood damages, the design uncertainties, and the cost of the project was performed in determining the design. (Sims-ISWS)
W79-07549

FLOW RESISTANCE IN COBBLE AND BOULDER RIVERBEDS, Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

D. B. Simon.
Journal of the American Society of Civil Engineers, Proceedings Paper 12 ref, 2 app.

Descriptors: *Sediments, *Streams, *Flow, *Sands, *Drainage, *Channel flow.

Field evidence presented the inflow of a channel to flow cobbles, riverbeds fill elements, bed channel coefficient, decreases, water discharge and (3) velocity estimate the of accuracy of improper of overestimation of scour design river control
W79-07550

FLOW CHARACTERISTICS, S. V. Regier, S. V. Regier, P. R. Mehrotra, Journal of the American Society of Civil Engineers, Proceedings Paper 12 tab, 9 ref.

Descriptor: characteristics, Mathematical models, theory tests, ity, Shear flow, flow, Assumptions, Assumptions.

Flow pattern, two-dimensional, mathematical analysis, physical models, in good agreement, findings, metric analysis, occurred almost type of flow, hence developed, ment. Flow for larger, W79-07551

COLLIERIES, WELLINGTON, Western Engineer, B. Hebbeler, Journal of the American Society of Civil Engineers, Proceedings Paper 2 tab, 9 ref.

Descriptor: *Water, *Model, *Streamflow, *Temperature, *River(A), *Reservoir.

Field evidence, reservoir.

Streamflow and Runoff—Group 2E

D. B. Simons, K. S. Al-Shaikh-Ali, and R-M. Li. Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY5, Proceedings Paper 14576, p 477-488, May 1979. 12 fig, 12 ref, 2 append.

Descriptors: *Streamflow, *Flow resistance, *Sediments, Beds, Beds under water, River beds, Streams, Rivers, Floods, Flood control, Flood flow, Sands, Gravels, Boulders, Model studies, Hydraulic models, Mannings equation, Channels, Channel flow, Roughness(Hydraulic), Hydraulics.

Field evidence and experimental evidence were presented to demonstrate the importance of the inflow of sand and gravel size sediments on resistance to flow in channels whose beds are primarily cobbles, rocks, and boulders. The released sediments fill the spaces between the larger roughness elements, forcing the channel to behave as a sand bed channel at a much reduced resistance to flow coefficient. Resistance to flow in these channels decreases, resulting in underestimations of: (1) water discharge by a factor of 2; (2) sediment discharge by a factor ranging between 8 and 64; and (3) velocity of flow by a factor of 2. Failure to estimate these quantities with a reasonable degree of accuracy results in the following: (1) underestimation of the actual quantity of available water; (2) improper selection of bank protection material; (3) overestimation of reservoir life; (4) unsafe design of scour depths at hydraulic structures; (5) improper design of location; and (6) others relating to river control and development. (Sims-ISWS) W79-07550

FLOW CHARACTERISTICS IN TWO-DIMENSIONAL EXPANSIONS.

S. V. Regional Coll. of Engineering and Technology, Surat (India). Dept. of Civil Engineering. P. R. Mehta.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY5, Proceedings Paper 14579, p 501-516, May 1979. 18 fig, 2 tab, 9 ref, 1 append.

Descriptors: *Flow, *Fluid mechanics, *Flow characteristics, *Flow separation, Model studies, Mathematical models, Numerical analysis, Laboratory tests, Hydraulic models, Turbulence, Viscosity, Shear, Streams, Channels, Walls, Channel flow, Analytical techniques, Hydraulics, Expansion, Asymmetry, Shear flow.

Flow patterns for recirculating flows in sudden two-dimensional expansions were obtained by numerical approaches and experimental studies. Analytical results for low expansion ratio of 1.25 were in good agreement with those of experimental findings. For larger expansion ratios, experimental findings revealed that the flow patterns were asymmetric and unstable. Two distinct types of flow occurred in which the flow characteristics were almost the mirror image of one another in each type of flow. For large expansion ratios, turbulence developed peak values early and also decayed at faster rate after the points of reattachment. Flow attained symmetric conditions earlier for larger expansion ratios. (Sims-ISWS) W79-07551

COLLIE RIVER UNDERFLOW INTO THE WELLINGTON RESERVOIR.

Western Australia Univ., Nedlands. Dept. of Civil Engineering.

B. Hebbert, J. Imberger, I. Loh, and J. Patterson. Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY5, Proceedings Paper 14593, p 533-545, May 1979. 7 fig, 2 tab, 9 ref, 2 append.

Descriptors: *Reservoirs, *Rivers, *Underflow, *Water quality, *Australia, On-site investigations, Model studies, Mathematical models, Flow, Streamflow, Entrainment, Salinity, Density, Temperature, Water temperature, *Collie River(Australia), *Wellington Reservoir(Australia).

Field data gathered from a Western Australian reservoir were used to obtain an estimate for the

entrainment coefficient of the underflowing river. By the use of a steady, normal-flow theory, the entrainment coefficient is related to the flow and river channel characteristics. By combination with a general turbulent entrainment law, it was shown that the entrainment coefficient and dilution may be directly related to the physical characteristics of the river channel, and thus may be estimated without recourse to a field experiment. In order to determine the initial underflow depth and the location of the plunge line, a simple theory using the concept of a normal flow depth was used, the results of which compared favorably with observation. (Sims-ISWS) W79-07552

INTERACTION BETWEEN MAIN CHANNEL AND FLOOD-PLAIN FLOWS.

Alberta Univ., Edmonton. Dept. of Civil Engineering.

N. Rajaratnam, and R. M. Ahmadi. Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY5, Proceedings Paper 14591, p 573-588, May 1979. 12 fig, 1 tab, 17 ref, 2 append.

Descriptors: *Flood flow, *Flood plains, *Open channel flow, Momentum transfer, Flow, River flow, Rivers, Channels, Turbulent flow, Roughness(Hydraulic), Shear stress, Model studies, Hydraulic models, Laboratory tests, Hydraulics, Velocity, Profiles, Hydrology.

The experimental results presented in this paper demonstrated the transport of longitudinal momentum from the main channel to the floodplain. This transport increased the bed shear stress in the floodplain and produced the opposite result on the main channel. The velocity profiles in the region affected by this interaction were found to be similar if viewed with respect to the undisturbed flow in the floodplain. The velocity and length scales were correlated with the ratio of the depth of flow in the main channel to that in the floodplain. In these experiments, the main channel was narrow, and thus the interaction extended inwards to the center line of the main channel. For the concepts introduced in this paper to be used in solving practical problems, further experiments should be conducted with wider main channels, including the effects of bed roughness. (Sims-ISWS) W79-07553

WAVE RUN-UP INFLUENCE ON OVERTOPPING OF LEVEES.

Agricultural Univ., Wageningen (Netherlands). Dept. of Hydraulics and Catchment Hydrology.

D. H. Keuning, and J. B. M. van Acker. Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY5, Proceedings Paper 14588, p 589-604, May 1979. 6 fig, 9 tab, 6 ref, 2 append.

Descriptors: *Levees, *Flood waves, *Winds, *Wave pile-up, Rivers, Flood plains, Model studies, Mathematical models, Stochastic processes, Probability, Floods, Waves(Water), Wind velocity, *Waal River(The Netherlands), *The Netherlands, Overtopping, Wave runup.

A procedure for calculating probabilities of overtopping from the combined occurrence of floods and wave runup with an application to a section of the Waal river in the Netherlands was presented. Annual exceedance probabilities were known for the floods. Runup was computed from wind velocity and wind direction. A stochastic model for these quantities was established, based on a record of 10-yr wind observations. The model was used for generating a series of wind velocities and directions. Combining these sequences with floods, the magnitude of the runup and the probabilities of overtopping for some heights of the levee were computed. The sensitivity of the results with respect to the shape of the flood waves and the simulation models for runup was studied. (Sims-ISWS) W79-07554

HYDROLOGIC EFFECTS OF BRUSH CONTROL ON TEXAS RANGELANDS.

Science and Education Administration, Temple, TX.

For primary bibliographic entry see Field 2A. W79-07558

METHODOLOGIES FOR THE DETERMINATION OF FLOW DURATION CURVES AT SPECIFIC SITES ON UNGAGED REACHES OF STREAMS.

Idaho Univ., Moscow. Graduate School. R. L. Emmert.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 397. Price codes: A07 in paper copy, A01 in microfiche. M.S. Thesis, May 1979. 126 p, 50 fig, 27 tab, 18 ref. OWRT A-057-IDA (1), 14-34-0001-9014.

Descriptors: *Flow duration, Streamflow, Hydrologic data, Duration curves, Regional analysis, Hydroelectric power.

This study examines several techniques for synthesizing flow duration curves, at ungaged river sites, for application to hydro-electric energy surveys of entire river systems. Three techniques are presented which can be utilized on natural flowing rivers. Data requirements consist of existing streamflow records and compilations of area-precipitation products. The procedures are based on regression equations and normalization of existing flow duration curves. The three techniques are applied to the Clearwater River in Idaho and a comparison of their results is made. A fourth technique is presented for synthesizing flow duration curves for regulated streams using similar data input as for the three natural flow methods. This procedure is applied to the regulated portions of the Priest and Payette Rivers in Idaho. The Method is also applicable to natural streams and this is illustrated by application to the Clearwater River. Comparisons of synthetic results to actual discharge and energy values for various exceedance percents along with percent differences are presented to give indications of error magnitudes. (Gladwell-Idaho) W79-07579

JUNCTION LOSSES IN OPEN CHANNEL FLOWS.

Connecticut Univ., Storrs. Dept. of Civil Engineering.

J. D. Lin, and H. K. Soong. Water Resources Research, Vol. 15, No. 2, p 414-418, April 1979. 6 fig, 3 tab, 8 ref. OWRT A-051-CONN (4), 1431-0001-3507.

Descriptors: *Open channel flow, Energy loss, Manning equation, Flow rates, Flow friction, One-dimensional flow, Turbulent mixing, Lateral inflow.

The energy balance of spatially varied flows at the junction of a rectangular open channel and a side channel is investigated by a one-dimensional flow analysis of experimental data obtained from a laboratory channel system. By means of a large control volume enclosing the neighborhood of the junction and having the control surface located at the cross sections where the flow is unidirectional, the energy loss can be evaluated. The energy loss is then divided into two components: the boundary friction loss and the turbulent mixing loss. The turbulent mixing loss is found to be of the same order of magnitude as the boundary friction loss evaluated by Manning's formula. The loss coefficient is derived as a function of the ratio of lateral to total flow rate. An energy transfer process from the main channel flow to the lateral inflow or vice versa, which is implicit in the one-dimensional flow analysis, can be analyzed by means of the turbulent mixing loss coefficients. The result may be applied to the calculation of energy losses in the junction or in spatially varied flows with lateral inflow in an open channel flow analysis. (de Lare-Conn) W79-07582

HYDROLOGIC DATA FOR NORTH CREEK, TRINITY RIVER BASIN, TEXAS, 1976.

Geological Survey, Austin, TX. Water Resources Div.

Field 2—WATER CYCLE

Group 2E—Streamflow and Runoff

C. C. Kidwell.

Geological Survey open-file report 77-732, July 1978. 42 p, 2 fig, 3 tab.

Descriptors: *Hydrologic data, *Streamflow, *Rainfall-runoff relationships, *Retaining walls, *Floodwater, Gaging stations, Discharge(Water), Hydrographs, Mass curves, Flood control, Small watersheds, Texas, *North Creek, *Trinity River basin.

This report contains rainfall and runoff data collected during the 1976 water year for a 21.6-square mile area above the stream-gaging station on North Creek near Jacksboro, Texas. A continuous water-stage recording gage was installed at one representative floodwater-retarding structure (site 28-A) on Oct. 5, 1972. The data are used to compute the contents, surface area, inflow, and outflow at this site. The stream-gaging station on North Creek near Jacksboro continuously records the water level which, with measurements of streamflow, is used to compute the runoff from the study area. Streamflow records at this gage began on Aug. 8, 1956. Detailed rainfall-runoff computations, including hydrographs and mass curves, are included for two storm periods during the 1976 water year at the stream-gaging station. (Woodard-USGS) W79-07698

NUTRIENT RELATIONSHIPS IN THE DETRITUS OF A TROPICAL SWAMP.

Makerere Univ., Kampala (Uganda). Dept. of Botany.
For primary bibliographic entry see Field 2K. W79-07736

PERMEABLE WALL EFFECTS ON POISEUILLE FLOW.

Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
P. L.F. Liu.
Journal of the Engineering Mechanics Division, American Society of Civil Engineers, Vol. 105, No. EM3, Technical Note, p 470-476, June 1979. 2 fig, 2 tab, 8 ref, 1 append. NY Sea Grant Institute 44-S043-C, 44-S051-C.

Descriptors: *Viscous flow, *Boundaries(Surfaces), *Porous media, *Earth-water interfaces, Permeability, Boundary layers, Theoretical analysis, Analytical techniques, Velocity, Profiles, Hydraulics, Flow, Laboratory tests, Porosity, Boundary processes, Poiseuille flow, Permeable boundary, Two-dimensional flow.

The effects of permeable walls on Poiseuille flow were investigated. Due to the transfer of forward momentum across the permeable interface, a very thin boundary layer region is induced within the porous material adjacent to the interface. The boundary layer structure was found, and it depends strongly on the properties of the material in the boundary regions. The present theory agrees with available experiments very well. However more controlled experimental data are still needed. The results presented can be extended to study the interactions between water waves and seabed, which usually consist of permeable material. Although the unsteadiness becomes one of the new features of these types of problems, the oscillatory laminar (or turbulent) boundary layer above the interface in the free fluid is equivalent to the Poiseuille flows considered in the paper. The boundary layer flow within the permeable material (or seabed) could have significant influence on determining the mass transport velocity under the waves. (Humphreys-ISWS) W79-07749

THE HYDROLOGICAL RESPONSE OF HEADWATER AND SIDESLOPE AREAS.

Institute of Hydrology, Wallingford (England). K. Beven.
Hydrological Sciences Bulletin, Vol. 23, No. 4, p 419-437, December 1978. 10 fig, 3 tab, 14 ref.

Descriptors: *Basins, *Headwaters, *Rainfall-runoff relationships, Watersheds(Divides), Channels, Storms, Hydrology, Discharge(Water), Peak

discharge, Flow, Velocity, *Sideslope areas, Hydrologic response, Convergent headwater, Divergent sideslope.

This paper showed that the hydrological response of convergent headwater and divergent sideslope areas, within a broadly homogeneous basin, may be expected to be significantly different. A field study of 3 headwater and 2 sideslope areas of the order of 0.25 sq km in the Crimpe Beck catchment, Yorkshire, England, was described. Spatial variations in gauged rainfall inputs to the sub-basin areas were shown to be small relative to differences in hydrological response. Results from winter and spring storms showed that the headwater areas will generally provide significantly higher and earlier peak flows per unit area and more total storm discharge than the sideslope areas. Areas of surface saturation of the soil are most commonly found during and between storms in convergent hollow areas associated with ephemeral channels, expanding as variable contributing areas of surface flow during storm rainfall. In this basin, however, there was also a tendency for both headwater and sideslope sub-basins to generate surface flow on large areas of saturated soil during storms. Measured unchanneled surface flow velocities were very slow (approximately 20 m/h) and suggested that, in this particular situation, the differences in the response of headwater and sideslope areas may be largely due to the role of the network of minor channels commonly found in convergent headwater areas. These, often ephemeral, channels transmit surface water to the permanent stream network efficiently and rapidly. In the sideslope areas, generally lacking such channels, surface water will be delayed, and may be delayed sufficiently to infiltrate before reaching a channel when rainfall ceases. (Lee-ISWS) W79-07755

EFFECTS OF CHANNEL ENLARGEMENT BY RIVER ICE PROCESSES ON BANKFULL DISCHARGE IN ALBERTA, CANADA.

Calgary Univ. (Alberta). Dept. of Geography.
D. G. Smith.
Water Resources Research, Vol. 15, No. 2, p 469-475, April 1979. 5 fig, 3 tab, 19 ref.

Descriptors: *Channel morphology, *Ice, *Discharge(Water), *Canada, *Australia, *England, *United States, Rivers, Channel flow, Scour, On-site data collections, Analysis, Ice jams, On-site investigations, Frequency, Stream erosion, Ice breakup, Foreign research, Channel enlargement, Bankfull discharge.

Results from 24 rivers studied in Alberta showed that bankfull recurrence intervals average 16.7 yr, ranging between 2.4 and 45 yr. These results differ sharply from the average of 1.6 yr for rivers in warmer countries such as Great Britain, Australia, and the United States. The difference in frequency of return period for Alberta rivers may be attributed to channel enlargement caused by the occurrences of scour from ice breakup, drives, and jams of unknown frequencies. The enlarged channel areas (cross sections) at bankfull average 2.6 times larger, but due to comparison adjustments, may be 3 times larger than comparable rivers at bankfull in the United States, and are thus able to carry an average of 4.7 times more discharge, taking into account the increase in velocity. Research is particularly needed on the role of river ice jams and drives in shaping channel geometry. (Humphreys-ISWS) W79-07756

A MONTE CARLO ANALYSIS OF THE HYDROLOGIC EFFECTS OF SPATIAL VARIABILITY OF INFILTRATION.

Science and Education Administration, Fort Collins, CO.
For primary bibliographic entry see Field 2G. W79-07760

CHOOSING AMONG ALTERNATIVE HYDROLOGIC REGRESSION MODELS.

Universidad Simon Bolivar, Caracas (Venezuela). J. B. Valdes, G. J. Vicens, and I. Rodriguez-Iturbe.

Water Resources Research, Vol. 15, No. 2, p 347-358, April 1979. 7 fig, 12 tab, 13 ref. NSF GK-41643X.

Descriptors: *Streamflow, *Floods, *Model studies, *Regression analysis, Mathematical models, Flow, Probability, Statistics, Precipitation(Atmospheric), Rainfall, Snowfall, Drainage area, Forests, Soils, Annual flood, Hydrology, Bayesian theory.

Bayesian theory provides for the explicit accounting of both parameter and model uncertainties. It was used in this work to derive a procedure for discriminating among alternative hydrologic regression models. In particular, the procedure was used to discriminate among alternative exogenous variables in regression models. Controlled experiments with hydrologic models were designed to test the proposed procedure under different assumptions on model prior probabilities, length of sample, and model subset. These examples showed that besides its theoretical advantages, the use of the Bayesian procedure unambiguously selects the correct model in most of the applications. (Sims-ISWS) W79-07763

PROMISING STRATEGIES FOR RESERVING INSTREAM FLOWS.

Dewnapu (Richard L.)/Dallin W. Jensen, Salt Lake City, UT.
For primary bibliographic entry see Field 6A. W79-07878

NATIONAL WATER QUALITY GOALS CANNOT BE ATTAINED WITHOUT MORE ATTENTION TO POLLUTION FROM DIFFUSED OR 'NONPOINT' SOURCES.

General Accounting Office, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-275 290, Price codes: A04 in paper copy, A01 in microfiche. Report to the Congress December 20, 1977, 29 p.

Descriptors: *Pollution abatement, *Water pollution sources, *Water quality, *Water quality control, Pollutants, Political aspects, Water quality standards, Water pollution control, Pollutant identification, Planning, Drainage, Drainage effects.

'Nonpoint' sources of water pollution -- sediment, acid mine drainage pesticides, and other pollutants carried into streams by runoff from rainstorms -- currently produce more than half of the pollutants entering the nation's waterways. If not controlled, nonpoint pollution will prevent attainment of national water quality goals and will continue to grow in significance as 'point' sources of pollution, such as factories and municipal waste treatment plants, are brought under control. Because the source of discharge is diffuse, nonpoint pollution is difficult to collect and treat. The best way to control it is to prevent as much of it as possible from reaching the water through proper land management. The federal Environmental Protection Agency (EPA) should plan more solutions to nonpoint water pollution sources. Because funds for water pollution control are limited, better data is needed to set priorities and evaluate alternatives for controlling water pollution. The EPA agrees that greater nonpoint source control effort is needed at federal, state and local levels. The EPA believes that the present program structure is the best possible, considering the various program constraints. (Fortin-Florida) W79-07889

EXCEEDANCE PROBABILITY - DEPTH RELATIONSHIPS OF FLOODS FOR MARYLAND STREAMS WEST OF CHESAPEAKE BAY.

Geological Survey, Towson, MD. Water Resources Div.
W. J. Herb.
Geological Survey open-file report 78-171, March 1978. 14 p, 4 fig, 2 tab, 4 ref.

Descriptors: *Flood frequency, *Peak discharge, *Flood forecasting, *Regression analysis, *Maryland, Streams, Flood profiles, Flood stages, Flood protection, *Flood-depth relationships.

Regression drainage area Western SI which may with exceed percent. A reader to co elevation at W79-07942

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2F. Gro

GROTHER ASSESSMENT GROTHER STATES, Geonomics Available for Service, Sp Price codes Interagency Development 1977 68-03-2468.

Descriptor: *Water an collections, Seismology Geysers(C Grande R Groundwa Groundwa developme

A compila iting data chemistry Valley and Falls, Oreg Mexico. T line data a nonmental groundwater The Imper through un active faul cant subsid and contain A new co resulted fr merous fa the mount ogy and w ge basins occurring ciated with tured basali in this vey low containing terest, is c folding in throughout saline wa water vari W79-07950

EFFECT AND ENV DOWN, North Ca Biological R. W. Skat Transac natural Eng April 1978

Descriptor: *Mathem Equations

Groundwater—Group 2F

Regression analysis of flood-depth frequency and drainage area data for 46 streams on Maryland's Western Shore produced equations and curves which may be used to estimate depths of floods with exceedance probabilities of 50, 20, 10, 2, and 1 percent. A procedure is outlined to allow the reader to convert the estimated flood depths to an elevation above the streambed. (Woodard-USGS) W79-07941

TECHNIQUE FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS IN DELAWARE.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 6A. W79-07942

2F. Groundwater

GEO THERMAL ENVIRONMENTAL IMPACT ASSESSMENT: BASELINE DATA FOR FOUR GEO THERMAL AREAS IN THE UNITED STATES.
Geonomics, Inc., Berkeley, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-295 609. Price codes: A22 in paper copy, A01 in microfiche. Interagency Energy-Environment Research and Development Report No. EPA-600/7-78-188, September 1978. 358 p, 99 fig, 23 tab, 27 ref, 5 append. 68-03-2468.

Descriptors: *Geothermal studies, *Geysers, *Water analysis, *Water chemistry, *Basic data collections, Climatic data, Geology, Hydrology, Seismology, Imperial Valley(California), The Geysers(California), Klamath Falls(Oregon), Rio Grande Rift Zone(New Mexico), Groundwater, Groundwater resources, Groundwater availability, Groundwater basins, Technology, Research and development, Assessment, Thermal water.

A compilation and technical assessment of the existing data on climate, geology, hydrology, water chemistry and seismicity is presented for Imperial Valley and The Geysers in California, Klamath Falls, Oregon, and the Rio Grande Rift Zone, New Mexico. The information is the first step, or baseline data assessment, towards developing an environmental monitoring methodology emphasizing groundwater degradation for geothermal areas. The Imperial Valley, a sediment-filled structural trough undergoing intensive crustal deformation, active faulting, very high seismicity, and significant subsidence, displays high regional heat flow and contains six known geothermal resource areas. A new comprehensive fault map of the valley has resulted from the extensive data compilation. Numerous faults and notable seismic activity occur in the mountainous region of The Geysers. Hydrology and water quality are discussed for mine drainage basins in this region. The geothermal waters occurring in the Klamath Basin appear to be associated with faults and are located in rubby, fractured basalt aquifers. Four main aquifers are identified in this area which historically has displayed very low seismicity. The Rio Grande Rift Zone, containing seven areas of potential geothermal interest, is difficult to interpret because of complex folding in the mountains and discontinuous faulting throughout. The drainage basins contain much saline water, and the available volume of fresh water varies. (Davison-IPA) W79-07504

EFFECT OF DRAIN DIAMETER, OPENINGS AND ENVELOPES ON WATER TABLE DRAWDOWN.
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs, and Y. K. Tang.
Transactions of the American Society of Agricultural Engineers, Vol. 22, No. 2, p 326-333, March-April 1979. 10 fig, 4 tab, 17 ref.

Descriptors: *Drains, *Drawdown, *Water table, *Mathematical models, *Groundwater movement, Equations, Unsaturated flow, Saturated flow,

Drainage systems, Depth, Soil profiles, Hydraulic conductivity, Hydraulic properties, Water levels, Computer models, Richards equations, Parallel drains, Effective radius, Envelopes.

Numerical solutions to the Richards equation for saturated and unsaturated flow to parallel drains were used to determine the effects of drain tube diameter, openings, and envelopes on water table drawdown. Conventional drain tubes with a finite number of openings in the walls were represented as completely open tubes with an effective radius, r sub e . The effect of drain tube size and the use of envelopes on water table drawdown were determined for different soils, drain spacings, and profile depths. It was concluded that envelopes will allow an increase in drain spacing without reducing the design drawdown rate. However, the allowable spacing increase is smaller than previously reported in the literature. The midpoint drawdown rate was found to be relatively insensitive to changes of one or two sizes in the drain tube diameter. Finally, it was shown that the effect of drain tube diameter on drainage rates is dependent on drain spacing and profile depth as well as hydraulic properties of the soil. (Visocky-ISWS) W79-07545

GROUNDWATER CONTOUR MAPPING IN VENICE BY STOCHASTIC INTERPOLATORS, 1. THEORY.
IBM Scientific Center, Venice (Italy).
G. Gambolati, and G. Volpi.
Water Resources Research, Vol. 15, No. 2, p 281-290, April 1979. 10 fig, 4 tab, 12 ref.

Descriptors: *Groundwater, *Aquifers, *Mapping, *Model studies, Mathematical models, Water levels, Land subsidence, Saline water intrusion, Piezometry, Theoretical analysis, Stochastic processes, Analytical techniques, Hydrology, *Venice(Italy), Kriging techniques.

An adaptation of the kriging technique was developed and used to map the hydraulic head field, z , of three major aquifers underlying the Venetian lagoon. Available records came from a fairly small number of observation wells unevenly scattered across the mainland, Venice, and the littoral. The event to be reconstructed was conceptually idealized as the sum of (1) a deterministic component, m , giving the main trend of z , and (2) a stochastic component, e , giving the natural dispersion of z around m with zero mean, constant variance, and high autocorrelation. Both m and e were dependent on the observation scale. A physically based expression for m was selected, including the consideration of additional information related to the general hydrogeological context. To reduce the complexity of the choice, some unknown coefficients, a sub k , were introduced in m and determined 'a priori' by a best fit technique, for instance, the least squares method. The relationship between m and a sub k was not necessarily linear. The dispersion e was then assessed by a linear optimal stochastic interpolator, i.e., by a linear combination of the observed values with the requirement that the variance of the interpolation error, E , be minimal. Validation of the interpretation models selected for each of the three Venetian aquifers showed that the present approach yields accurate results provided the trend is correctly assessed. (See also W79-07560) (Sims-ISWS) W79-07559

GROUNDWATER CONTOUR MAPPING IN VENICE BY STOCHASTIC INTERPOLATORS, 2. RESULTS.
IBM Scientific Center, Venice (Italy).
G. Volpi, G. Gambolati, L. Carbognin, P. Gatto, and G. Mozzi.
Water Resources Research, Vol. 15, No. 2, p 291-297, April 1979. 10 fig, 1 tab, 5 ref.

Descriptors: *Groundwater, *Aquifers, *Mapping, *Model studies, Mathematical models, Water levels, Land subsidence, Saline water intrusion, Piezometry, Stochastic processes, Analytical techniques, Hydrology, *Venice(Italy), Kriging techniques.

Reliable and flexible tools are required to keep under control the subsurface flow field of the Venetian lagoon and the related land subsidence. One such tool was given by the stochastic interpolator developed in paper 1 and used to map the 1973 and 1977 piezometry of three major Venetian aquifers. A fairly small number of test holes unevenly scattered across the mainland, Venice, and the littorals provided the input data. The output was the reconstructed hydraulic head together with an assessment of its reliability. The 1973 results showed the existence of a pronounced cone of depression centered upon the industrial area of Porto Marghera, which turned out to be by far the major pumping site in the whole area. Local withdrawals produce a minor cone in Venice, but they do not account for the overall head decline recorded there. The 1977 contour maps showed a substantial recovery of the flow field in the upper 250 m of the groundwater basin, thus providing documentary evidence for the recently observed rebound of the land surface. Significant residual withdrawals still occur in the lowest unit (approximately 280 m) of the aquifer system. (See also W79-07559) (Sims-ISWS) W79-07560

MAP OF ANTELOPE VALLEY-EAST KERN WATER AGENCY AREA, CALIFORNIA, SHOWING GROUND-WATER SUBUNITS AND AREAS, LOCATION OF WELLS, AND LINES OF EQUAL DEPTH TO WATER FOR SPRING, 1978.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7C. W79-07701

U.S. GEOLOGICAL SURVEY, DENVER, COLORADO, RADIOCARBON DATES II.
Geological Survey, Denver, CO. Water Resources Div.
L. J. Schroder, R. L. Emerson, and W. A. Beetern.
Radiocarbon, Vol 20, No 2, p 200-209, 1978. 2 tab, 4 ref.

Descriptors: *Radioactive dating, *Groundwater, *Carbon radioisotopes, *Alkalinity, Sampling, Water wells, *Carbon-14.

This list includes C-14 measurements made between 1969 and 1973 that represent natural water samples. Calculations of dates are made with the radiocarbon half-life of 5568 ± 40 - 30 years; plus or minus numbers quoted are the standard errors for the counting of radioactive disintegrations. The C-13 values reported are based on Craig PDB limestone standard (Craig, 1957) and were determined by Teledyne Isotopes, Inc., Westwood Laboratories (R, 1968, v 11, p 53-105). The total alkalinity as bicarbonate values reported were determined using techniques described by Brown and others (1970). All dates reported in this list are from water samples collected by members of the U.S. Geological Survey. The measurement of C-14 ages was financed through the Nevada Operations Office, U.S. Energy Research and Development Agency, formerly U.S. Atomic Energy Commission. (Woodard-USGS) W79-07707

DETERMINATION OF HYDROLOGIC PARAMETERS FOR GLACIAL TILLS IN CONNECTICUT.
Connecticut Univ., Storrs. Inst. of Water Resources.
D. Huntley, and R. B. Black.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 578. Price codes: A02 in paper copy, A01 in microfiche. Research Project Technical Completion Report, 1979. 19 p, 4 tab, 6 fig, 12 ref. OWRT A-077-CONN(2), 14-34-0001-7014.

Descriptors: *Hydrologic properties, *Glacial soils, Hydrogeology, *Transmissivity, Computer model, *Waste disposal, Aquifer characteristics, *Glacial till, *Contaminant transport, *Waste movement, Sanitary landfills, *Anisotropic flow, *Permeameters, Slug tests, Stratified sediments,

Field 2—WATER CYCLE

Group 2F—Groundwater

Quinebaug River Basin, Shetucket River Basin, Connecticut.

Glacial tills located in the upland areas of the Shetucket and Quinebaug River basins, Connecticut, were evaluated for transmissivity and hydraulic conductivity by performing slug-injection tests on nine, small diameter drilled wells and slug-withdrawal tests on nineteen existing, dug wells. Test data, analyzed using the type-curve method of Cooper et al. (1967) and Papadopoulos et al. (1973) yielded values of horizontal hydraulic conductivity that ranged from 1.0 to 355 gpd/ft² (0.13 to 14.46 m/day). Laboratory-determined values of horizontal hydraulic conductivity were obtained using specially-constructed permeameters on relatively undisturbed samples of till. Although grain-size distributions for these samples show a wide range of values, this variability was not reflected in the hydraulic conductivities, which ranged from 13 to 80 gpd/ft² (0.53 to 3.26 m/day). A computer-model simulation utilizing the permeability contrasts and anisotropic nature of the till indicated that large variations of contaminant transport existed in the hypothetical aquifers when an average horizontal hydraulic conductivity is assumed for the till rather than accounting for high-hydraulic conductivity layers that might exist. Computer-model simulations of waste movement through a till aquifer, such as those presented in this study, have widespread application relative to the design of sanitary landfills and other forms of waste disposal in till and stratified sediments. (de Lara-Conn)

W79-07715

VARIATIONS IN SPECIFIC YIELD IN THE OUTCROP OF THE CARRIZO SAND IN SOUTH TEXAS AS ESTIMATED BY SEISMIC REFRACTION.

Texas Dept. of Water Resources, Austin.
G. L. Duffin, and G. R. Elder.
Report 229, April 1979. 61 p, 9 fig, 3 tab, 13 ref.

Descriptors: *Sand aquifers, *Seismic studies, *On-site tests, *Texas, Aquifers, Seismic properties, Groundwater resources, Porous media, Groundwater, Seismic waves, Saturated soils, On-site data collections, Methodology, Instrumentation, Testing procedures, Porosity, Aquifer characteristics, Specific yield, Water table aquifers, Zone of saturation, Travel time, Sound waves, Carrizo Sand(TX), Unsaturated zone.

Seismic soundings were made at 84 sites, situated along 20 profiles, on the outcrop of the Carrizo Sand in south Texas. These soundings were made to estimate lateral variations in the aquifer's total porosity and specific yield where the aquifer is under water-table conditions. Compressional wave velocities in the upper unsaturated portion of the aquifer were determined by refraction soundings. Empirical relationships were used to estimate total porosity values from the compressional wave velocities. Estimated specific yields were derived from the estimated total porosities. The porosity values obtained by these empirical methods agree closely with laboratory porosity determinations from core samples taken from 7 of the 84 seismic sounding sites. All of the averaged values for specific yield fall within the range usually specified for unconfined aquifers (5 to 35%). Because of depth limitations of equipment used in the soundings, it is probable that the estimated average specific yields from profiles spanning or nearly spanning the outcrop are more nearly representative of the full thickness of the aquifer than are the specific yields from profiles that parallel the strike. The higher specific yield values are found east of the Frio River and range from 26 to 32%. West of the Frio River, specific yield values range from 16 to 24%. (Humphreys-ISWS)

W79-07750

AN ISOTOPIC STUDY OF GROUNDWATER SEEPAGE IN THE CENTRAL KENTUCKY KARST.

Scottish Research Reactor Centre, East Kilbride.
R. S. Harmon.
Water Resources Research, Vol. 15, No. 2, p 476-480, April 1979. 3 fig, 2 tab, 24 ref.

Descriptors: *Karst hydrology, *Isotope studies, *Seepage, *Kentucky, *Groundwater, On-site investigations, Aquifers, Analytical techniques, On-site tests, On-site data collections, Stable isotopes, Groundwater movement, Flow, Meteoric water, Vadose water caves, *Great Onyx Cave(KY), *Mammoth Cave National Park(KY).

Ratios of 180/160 were determined for meteoric precipitation and vadose seepage at Great Onyx Cave in Mammoth Cave National Park from March through July 1973. Results of this study indicated that (1) the delta 180/dT for precipitation at this site is 0.38 parts per thousand/deg C, (2) short-term fluctuations in the 180/160 ratio of seepage water in the vadose zone above the cave do not affect the oxygen isotopic composition of the speleothem calcite precipitated in the cave, and (3) the residence time of seepage water in the vadose zone is about 2 weeks. From spot sampling of base level springs in November 1972, the isotopic composition of the karst groundwater body is estimated to be about delta 180 = -5.6 parts per thousand and delta D = -40 parts per thousand. (Humphreys-ISWS)

W79-07757

UNSTEADY INTERZONAL FREE SURFACE FLOW IN POROUS MEDIA.

Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2G.
W79-07768

JORDAN AQUIFER OF IOWA.

Geological Survey, Iowa City, IA.
P. J. Horick, and W. L. Steinhilber.
Miscellaneous Map Series 6, 1978. 20 ref, 3 maps.

Descriptors: *Aquifers, *Data collections, *Groundwater resources, *Iowa, Groundwater, Water quality, Maps, Geology, Water balance, Hardness(Water), Water properties, Chemical properties, Dissolved solids, Specific capacity, Water wells, Well data, Potentiometric level, Hydraulic properties, Artesian aquifers, *Jordan aquifer(Iowa).

The purpose of this atlas was (1) to define and describe the spatial relations and physical characteristics of the Jordan aquifer, (2) to present information on the occurrence availability, use, and chemical quality of water in the aquifer, and (3) to define and delineate changes in the potentiometric surface of the aquifer. The geohydrologic information was divided into 3 subject headings that were presented on separate atlas sheets—geology, hydrology, and chemical quality. The Jordan aquifer is the most productive water-yielding unit of the Cambrian-Ordovician aquifer system, and is one of the most dependable sources of water supply for large capacity wells in Iowa. The total thickness of the aquifer ranges from about 400 to 450 feet in east-central and southeastern Iowa to about 150 feet or less in western Iowa. The transmissivity of the aquifer is estimated to range from about 500 ft sq/day in the western part of the state to about 5,000 ft sq/day in the northeastern part. (Humphreys-ISWS)

W79-07769

THE CITRONELLE AQUIFERS IN MISSISSIPPI.

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W79-07940

SPRINGS OF FLORIDA.

Geological Survey, Tallahassee, FL. Water Resources Div.; and Florida Bureau of Geology, Tallahassee.
For primary bibliographic entry see Field 1A.
W79-07946

GROUND-WATER DATA FOR MICHIGAN, 1977.

Geological Survey, Lansing, MI. Water Resources

Div.

G. C. Huffman.
Geological Survey open-file report 79-332, 1979. 75 p, 3 fig, 3 tab, 101 ref

Descriptors: *Groundwater resources, *Michigan, *Water levels, *Aquifers, *Water quality, Water wells, Water yield, Water utilization, Well data, Hydrogeology, Hydrographs, Water level fluctuations, Water analysis, Chemical analysis.

This report summarizes data on ground-water levels in 157 observation wells, and provides information on water quality, well locations, depths, altitudes, and aquifers that they tap. Tabulated data include extremes of water levels for 1977 and for the period of record. Also tabulated is the pumpage of most major ground-water users in the State and quality data on selected wells sampled during 1975-77. Levels were generally below average in many wells during the year; however, levels returned to near normal by years end. During the year, water levels reached record highs in only 3 wells and dropped to record lows in 31 wells. (Woodard-USGS)

W79-07947

RECORDS OF GROUND-WATER RECHARGE AND DISCHARGE FOR THE EDWARDS AQUIFER IN THE SAN ANTONIO AREA, TEXAS, 1934-77.

Geological Survey, San Antonio, TX. Water Resources Div.
R. W. MacIay, and R. A. Rappmund.
Edwards Underground Water District Bulletin 37, February 1979. 21 p, 3 fig, 5 tab, 35 ref.

Descriptors: *Groundwater recharge, *Aquifers, *Water yield, *Water level fluctuations, Hydrogeology, Maps, Drainage area, Data collections, Sites, Precipitation(Atmospheric), Texas, *San Antonio area, *Edwards aquifer.

The average annual ground-water recharge to the Edwards aquifer in the San Antonio area, Texas, from 1934 through 1977 was about 589,200 acre-feet. A maximum annual recharge of 1,711,200 acre-feet occurred in 1958, and a minimum annual recharge of 43,700 acre-feet occurred in 1956. A maximum annual discharge of 960,900 acre-feet occurred in 1977, and a minimum annual discharge of 388,800 acre-feet occurred in 1955. The maximum annual discharge by wells was 406,800 acre-feet in 1971. In addition to the tables of data, the report contains two maps showing (1) the hydrologic features in the San Antonio area and (2) the drainage basins and data-collection sites. (Woodard-USGS)

W79-07949

NORTHERN GROUNDWATER AND ENGINEERING PROBLEMS RELATED TO GROUNDWATER FLOW.

Department of the Environment, Calgary (Alberta). Hydrology Research Div.
R. O. van Everdingen.
In: Hydrology Research Division, Annual Progress Reports and Short Research Notes, 1977-78. p 21-26, 1979. 2 fig, 7 ref. Environment Canada Inland Waters Directorate, Ottawa, Report Series No. 64. HR 74-2.

Descriptors: *Groundwater, *Groundwater flow, *Instrumentation, *Hydrologic systems, *Engineering, Gages, Pressure measuring instruments, Hydrology, Hydrologic data, On-site investigations, Recharge, Permafrost, Cold regions, Franklin Mountains(Canada), Mahony Lake(Canada), Lac des Bois(Canada).

Progress is summarized for the year 1977 for groundwater flow engineering related problems. Laboratory work was completed at the University of Calgary in determining radioactive and stable isotopes in rain, snow, ground ice, groundwater recharge, spring water evaporites, and precipitates. The on-going study of the frost mounds near Fort Norman involved the use of time lapse photography. Battery operated pressure recorders were installed in the karst areas of Mahony Lake and Lac des Bois to further investigate the hydrologic sys-

tems of the significant and July at frost mound guide for the Third (Davison-I) W79-07956

MATHEM FIELD, CH Department io). Hydro A. Vanden In: Hydro res Report 1979. 13 f Inland Wa No. 64. HR

Descriptors, *Saline Boundaries agement, Groundwa Canada).

A mathem used to sim the aquifer Brunswick pumping down and sion. The area to be ence grid, ditions. Re istics have hydraulic the pumpi from the and auxil program ment are ined, and simulate s discussed. U model par possible to pumping aquifer pa W79-0796

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Water In Soils—Group 2G

tems of these areas. One of the recorders indicated a significantly increased recharge rate during June and July after a rainy period. The frost blister type frost mounds have been described in a field trip guide for the Central Yukon-Alaska field trip of the Third International Conference on Permafrost. (Davison-IPA)
W79-07956

MATHEMATICAL MODELLING OF A WELL FIELD, CHATHAM, N. B.,
Department of the Environment, Ottawa (Ontario). Hydrology Research Div.
A. Vandenberg.
In: Hydrology Research Division, Annual Progress Reports and Short Notes 1977-78, p 90-109, 1979. 13 fig, 1 tab, 4 ref. Environment Canada Inland Waters Directorate, Ottawa, Report Series No. 64. HRO 77-2.

Descriptors: *Mathematical models, *Computer models, *Aquifer characteristics, *Well data, *Saline water intrusion, Pumping, Boundaries(Surfaces), Drawdown, Aquifer management, Hydrogeology, Groundwater movement, Groundwater resources, Chatham(New Brunswick Canada).

A mathematical model being formulated will be used to simulate the hydraulic head distribution of the aquifer supplying water to Chatham, New Brunswick. Simulation of past, present, and future pumping will indicate areas of excessive drawdown and areas subject to future salt water intrusion. The work to date includes the selection of the area to be modeled, the design of the finite difference grid, and the establishment of boundary conditions. Representative values of aquifer characteristics have been selected, a stable nonpumping hydraulic-head distribution has been obtained for the pumping simulations, the history of pumping from the Chatham well field has been simulated, and auxiliary routines for data display have been programmed. The results of each stage of development are described, auxiliary programs are examined, and a finite element model of the area to simulate steady-state hydraulic head surfaces is discussed. Using the steady-state concept and the model parameters as they are presently set up, it is possible to generate hydraulic surfaces for other pumping schedules or to make changes in the aquifer parameters. (Davison-IPA)
W79-07961

2G. Water In Soils

CAPILLARY PRESSURE-SATURATION RELATIONSHIPS FOR A FOREST SOIL,
Bureau of Land Management, Prineville, OR.
R. J. Lenhard, and G. L. Bloomsburg.
Transactions of the American Society of Agricultural Engineers, Vol. 22, No. 2, p 357-360, March-April 1979. 8 fig, 2 tab, 8 ref.

Descriptors: *Capillary action, *Saturation, *Forest soils, Soil moisture, Soil water, Soils, Pressure, Compaction, Soil compaction, Permeability, Soil water movement, Capillary water, Capillary conductivity, Forests.

The Brooks-Corey capillary pressure-saturation relationship was applied to a volcanic-ash influenced forest soil under various compaction treatments. The relationship was shown to be statistically valid for a range of capillary pressure heads from 60 to 5,165 cm of water by a goodness-of-fit analysis. (Sims-ISWS)
W79-07542

APPLICATION OF AN INFILTROMETER SYSTEM FOR DESCRIBING INFILTRATION INTO SOILS,
Science and Education Administration, Boise, ID. Northwest Watershed Research Center.
D. L. Brakensiek, W. J. Rawls, and W. R. Hamon. Transactions of the American Society of Agricultural Engineers, Vol. 22, No. 2, p 320-325, March-April 1979. 7 fig, 5 tab, 21 ref.

Descriptors: *Infiltrometers, *Infiltration, *Soil moisture, Moisture content, Equations, Data collections, On-site data collections, Theoretical analysis, Model studies, Rainfall-runoff relationships, Least squares method, Kinetics, Gr

Design and operation of an infiltrometer system were discussed. Analysis of the infiltrometer data was presented by estimation of the parameters in the Green and Ampt infiltration equation. The procedure for correcting the observed time scale for the initial period of surface nonsaturation was illustrated. The Green and Ampt equation satisfactorily simulates the observed infiltration rate curve. (Visocky-ISWS)
W79-07543

AIR AND WATER MOVEMENT IN POROUS MEDIA: COMPRESSIBILITY EFFECTS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J. -Y. Parlange, and D. E. Hill.
Soil Science, Vol. 127, No. 5, p 257-263, May 1979. 2 fig, 1 tab, 14 ref.

Descriptors: *Soil water movement, *Porous media, *Air, *Compressibility, Model studies, Mathematical models, Laboratory tests, Wetting, Soil water, Moisture content, Sands, Soils, Zone of aeration, Infiltration.

This study presented an analysis of air and water movement in a sand column. The analysis took air compressibility into account. The influence of air on water intake was assessed when water content was imposed at the soil surface. When air can move freely ahead of the wetting front, it was found that air compressibility is negligible, but that air movement increases water intake by a small percentage. When air must escape through the sand surface, air compressibility increases water intake by a small percentage, although the overall effect of air movement is to reduce water flow. The results of the theory were illustrated and confirmed from previous experimental observations. (Sims-ISWS)
W79-07544

EFFECT OF DRAIN DIAMETER, OPENINGS AND ENVELOPES ON WATER TABLE DRAWDOWN,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W79-07545

WIND PROFILE PARAMETERS AND TURBULENCE INTENSITY OVER SEVERAL ROUGHNESS ELEMENT GEOMETRIES,
Science and Education Administration, Manhattan, KS.
For primary bibliographic entry see Field 2D.
W79-07547

SIMULATION OF ARID RANGELAND WATERSHED HYDROLOGY WITH THE USDAHL-74 MODEL,
Science and Education Administration, Boise, ID. Northwest Watershed Center.
For primary bibliographic entry see Field 2A.
W79-07557

HYDROLOGIC EFFECTS OF BRUSH CONTROL ON TEXAS RANGELANDS,
Science and Education Administration, Temple, TX.
For primary bibliographic entry see Field 2A.
W79-07558

AN INTRODUCTION TO WISCONSIN WETLANDS - PLANTS, HYDROLOGY, AND SOILS,
Geological Survey, Madison, WI. Water Resources Div.
R. P. Novitzki.
Univ. of Wisconsin-Extension, 1815 University Ave. Madison, Wis. 53706. Wisconsin University-Extension, Geologic and Natural History Survey

report, February 1979. 19 p, 15 fig.

Descriptors: *Wisconsin, *Wetlands, *Soil types, *Soil-water-plant relationships, *Hydrologic budget, Marshes, Bogs, Swamps, Flooding, Vegetation, Water quality, *Wetlands classification, Grassy wetlands, Brushy wetlands, Forested wetlands.

Wetlands in Wisconsin are classified by plant communities and characteristics typical of each type are described. Grassy wetlands include seasonally flooded basins, wet meadows, marshes, and sedge meadows. Brushy wetlands include willow swamps, alder swamps, and brushy bogs. Forested wetlands include flood-plain forests, hardwood swamps, cedar swamps, and forested bogs. (Woodard-USGS)
W79-07706

UNIVERSAL CONSTANTS FOR SCALING THE EXPONENTIAL SOIL WATER DIFFUSIVITY,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
W. Brutsaert.
Water Resources Research, Vol. 15, No. 2, p 481-483, April 1979. 11 ref.

Descriptors: *Soil water, *Diffusivity, *Equations, *Mathematical models, Model studies, Wetting, Infiltration, Soil water movement, Sorption, Physical properties, Permeability, Transmissivity, Soils, Soil science, Universal constants.

The exponential form of the soil water diffusivity can be scaled either with the wetting front parameter $\phi \text{ sub } f = x \text{ sub } f/t$ to the 1/2 power or with the sorptivity $A \text{ sub } o = F/t$ to the 1/2 power; these variables, which arise in the problem of sorption in a dry soil, are $x \text{ sub } f$ the distance to the wetting front, t the time, and F the infiltrated water volume. It was shown that the three constants used in this scaling are not independent and that only one constant is needed. (Sims-ISWS)
W79-07754

THE HYDROLOGICAL RESPONSE OF HEAD-WATER AND SIDESLOPE AREAS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2E.
W79-07755

AN ISOTOPIC STUDY OF GROUNDWATER SEEPAGE IN THE CENTRAL KENTUCKY KARST,
Scottish Research Reactor Centre, East Kilbride.
For primary bibliographic entry see Field 2F.
W79-07757

A MONTE CARLO ANALYSIS OF THE HYDROLOGIC EFFECTS OF SPATIAL VARIABILITY OF INFILTRATION,
Science and Education Administration, Fort Collins, CO.
R. E. Smith, and R. H. B. Hebbert.
Water Resources Research, Vol. 15, No. 2, p 419-429, April 1979. 14 fig, 2 tab, 15 ref.

Descriptors: *Infiltration, *Variability, *Model studies, Mathematical models, Spatial distribution, Distribution patterns, Watersheds(Basins), Rainfall, Precipitation excess, Pondering, Runoff, Monte Carlo method, Mathematics, Stochastic processes, Hydrology.

Monte Carlo simulation was employed to analyze the effects of random distribution of soil infiltration properties on the hydrologic performance of catchment areas. Soil hydraulic parameters were distributed with log normal distribution as reported from previous field measurements. Although independent sampling units were assumed, a discussion was presented on the nature and effect of spatial dependence. The composite infiltration rate of an area was simply the average, at a particular moment, of the infiltration rate of all points within that area. Rigorous treatment of the topic is a forbidding problem in stochastic differential equations. Monte Carlo simulation was used here to

Field 2—WATER CYCLE

Group 2G—Water In Soils

study the effects of random distribution of soil properties on distribution of ponding time, composite areal rate, and bias due to variability in space. More accurate treatment for watersheds must also consider interaction of various points on the surface by way of overland flow paths. A distributed watershed simulation model was used for this purpose to demonstrate hydrograph bias due to deterministic spatial variability, and from random variation, plus the relation of bias to rainfall rate. An analysis was also made of the partial area contribution in early parts of storm runoff caused solely by random variation in surface soil properties. (Sims-ISWS)
W79-07760

USE OF SPECIFIC CONDUCTANCE AND CONTACT TIME RELATIONS FOR SEPARATING FLOW COMPONENTS IN STORM RUNOFF.
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 2B.
W79-07764

UNSTEADY INTERZONAL FREE SURFACE FLOW IN POROUS MEDIA.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
J. A. Liggett, and P. L.-F. Liu.
Water Resources Research, Vol. 15, No. 2, p 240-246, April 1979. 9 fig, 4 ref, 1 append. NSF ENG77-01479.

Descriptors: *Free surfaces, *Porous media, *Unsteady flow, *Model studies, Mathematical models, Hydraulic models, Permeability, Dams, Embankments, Hydraulics, Drawdown, Flow, Mathematics, Analytical techniques.

The behavior of the free water surface at discontinuities in permeability for steady flow has been known for more than 40 years and has been used in numerical solutions and flow net sketching. The present paper extended that analysis to unsteady flow, primarily for use in numerical solutions. For a rising free surface, the diffraction between zones was given in graphical form. For a falling free surface, (almost) no diffraction solution existed, and the free surface was either horizontal or tangent to the line of discontinuity. However, sharp curvatures may occur in the vicinity of a permeability change, so care must be exercised in extrapolating free surface slopes to neighboring regions. (Sims-ISWS)
W79-07768

2H. Lakes

THE TRANSPORT AND RESUSPENSION OF SEDIMENTS IN A SHALLOW LAKE.
Aeronautical Research Associates of Princeton, Inc., NJ.
Y. P. Sheng, and W. Lick.
Journal of Geophysical Research, Vol. 84, No. C4, p 1809-1826, April 1979. 24 fig, 1 tab, 32 ref.

Descriptors: *Sediment transport, *Lakes, *Lake Erie, *Great Lakes, Suspended load, Suspended solids, Waves (Water), Hydraulics, Lake sediments, Flow, Equations, Mathematical studies, Model studies, *Sediment resuspension, Sediment models, Wave hindcasting model, Shallow lakes.

The time-dependent flow and dispersion of suspended sediments in the western basin of Lake Erie are being studied by means of numerical models utilizing data from remote-sensing studies and flume experiments. Mechanisms of sediment dispersion included in the models are convection and turbulent diffusion, river loading, gravitational settling, and physical resuspension and deposition at the sediment-water interface. The time-dependent currents were computed by means of a free surface hydrodynamic model. A wave-hindcasting model was used to compute the wave parameters needed for estimation of shear stress generated at the sediment-water interface under given wind conditions. The rate of sediment resuspension as a function of

bottom shear stress and sediment properties was based on data from flume experiments using lake sediments. A series of numerical calculations with the models were performed on a two-dimensional lake with a variable bottom representing a transverse cross section of Lake Erie. It was found that wind direction and fetch length can significantly affect the sediment dispersion patterns. The two-dimensional and the three-dimensional models were both used to simulate realistic short-term events in Lake Erie, and the model outputs compared favorably with the synoptic surface sediment dispersion patterns deduced from the multispectral scanner data. (Lee-ISWS)
W79-07541

COLLIE RIVER UNDERFLOW INTO THE WELLINGTON RESERVOIR.
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W79-07552

THE NATURAL RESOURCES OF AGUA HEDIONDA LAGOON. REPORT NUMBER 16 ON CALIFORNIA COASTAL WETLANDS.
San Diego Univ., CA. Environmental Studies Center.
J. Bradshaw, B. Browning, K. Smith, and J. Speth. Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 996. Price codes: A08 in paper copy, A01 in microfiche. Prepared for Fish and Wildlife Service, Washington, D.C., Office of Biological Services, June, 1976. 110 p, 19 fig, 2 tab, 64 ref.

Descriptors: *Lagoons, *California, *Management, Wetlands, Natural resources, Land use, Dual purpose, Industry, Planning, Agua Hedionda Lagoon.

The greatest threat to the present status of the lagoon and its wetland habitats is the continuing pressure for development of the lagoon and its watershed. City zoning plans indicate the lagoon as open space and the periphery as residential, agricultural, and industrial. Use of the outer lagoon is more restricted; the primary use of this area is for a cooling water intake basin for a power plant. A descriptive inventory of the natural resources found on the lagoon is given as well as guidelines for the multiple-use, management, preservation, and enhancement of those resources. (Steiner-Mass)
W79-07731

NUTRIENT DYNAMICS OF FRESHWATER RIVERINE MARSHES AND THE ROLE OF EMERGENT MACROPHYTES.
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 2K.
W79-07734

NUTRIENT RELATIONSHIPS IN THE DETRITUS OF A TROPICAL SWAMP.
Makerere Univ., Kampala (Uganda). Dept. of Botany.
For primary bibliographic entry see Field 2K.
W79-07736

FOREST SITES, BOG PROCESSES, AND PEATLAND TYPES IN THE GLACIAL LAKE AGASSIZ REGION, MINNESOTA.
Lake States Forest Experiment Station, St. Paul, MN.
M. L. Heinzelman.
Ecological Monographs, Vol. 33, No. 4, p 327-373, Autumn 1963. 29 fig, 6 tab, 126 ref.

Descriptors: *Bogs, *Minnesota, Wetlands, Fens, Peat, Distribution patterns, Geomorphology, Classification, Forests, Ecological distribution.

The identity of the patterned bogs and fens of this region was established. Features that clearly mark the Lake Agassiz peatlands as members of the circumboreal group include string bogs (Strangmoor), topographically oriented forest islands, and fields of regularly spaced islands. The decisive

influence of water movement patterns on floristics and forest sites was underscored. The key seems to be the degree of isolation from mineral-influenced groundwater. The course of such waters through bogs is often marked by water-track vegetation types. A tentative classification of peatland types is proposed. (Steiner-Mass)
W79-07739

BIOLOGICAL PRODUCTION AND NUTRIENT STUDIES OF LAKE CHAMPLAIN.
Vermont Univ., Burlington. Dept. of Zoology.
For primary bibliographic entry see Field 2I.
W79-07741

EFFECTS OF SPRING WATER LEVELS ON THE REPRODUCTION OF UPPER RICHELIEU AND MISSISSQUOI BAY: NORTHERN PIKE (ESOX LUCIUS L.).
Quebec Univ., Montreal (Canada). Dept. of Biology.
For primary bibliographic entry see Field 2I.
W79-07742

LAKE CHAMPLAIN FISHERIES INVESTIGATION: UNITED STATES WATERS.
New York State Dept. of Environmental Conservation, Albany.
For primary bibliographic entry see Field 2I.
W79-07743

ANALYSIS OF ECONOMIC EFFECTS OF WATER SURFACE ELEVATIONS ON US SHORELINE OF LAKE CHAMPLAIN, NEW YORK AND VERMONT.
URS/Madigan-Prager, Inc., New York.
For primary bibliographic entry see Field 6B.
W79-07744

THE EFFECT OF LAKE DESTRATIFICATION ON WATER QUALITY.
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
J. M. Steichen, J. E. Garton, and C. E. Rice.
Journal of the American Water Works Association, Vol. 71, No. 4, p 219-225, April 1979. 13 fig, 1 tab, 11 ref. OWRT A-028-OKLA (3), 14-31-0001-4036.

Descriptors: *Destratification, *Lakes, *Water quality, Hypolimnion, Temperature, Water temperature, Oxygen, Dissolved oxygen, Pumping, Equipment, Hydrogen ion concentration, Carbon dioxide, Alkalinity, Biochemical oxygen demand, Conductivity, Plankton, Diatoms, Algae, Biology.

The effectiveness of a modified axial flow pump on thermal and dissolved oxygen stratification of a selected lake was measured according to physical-chemical and biological data. Mechanical variables—use of the pump with and without the diffuser, using diffusers of different materials, and varying the pitch of the propeller—were assessed to determine the optimum operating conditions for lake destratification. (Sims-ISWS)
W79-07745

BLACK WATER AND TWO PECULIAR TYPES OF STRATIFICATION IN AN ORGANICALLY LOADED STRIP-MINE LAKE.
Southern Illinois Univ. at Carbondale. Dept. of Zoology.
J. B. Stahl.
Water Research, Vol. 13, No. 5, p 467-471, 1979. 8 fig, 23 ref.

Descriptors: *Strip mine lakes, *Stratification, *Water quality, *Illinois, Surface waters, Lakes, Thermal stratification, Profiles, Iron, Alkalinity, On-site investigations, Sampling, On-site tests, Analysis, Dissolved oxygen, Hydrogen ion concentration, Water temperature, Data collections, *Jackson County (IL), Anoxic zone.

During summer stratification, a strip mine lake in which fish were cultured in floating cages developed black water in its anoxic zone. The blackness

Water In Plants—Group 21

evidently was produced by ferrous sulfide. Two types of black water stratification were observed. In one, the blackness occurred throughout the anoxic zone but was more intense in the upper part, while iron and alkalinity were high throughout this zone. In the second, the black water was confined to a meter-thick stratum within the anoxic zone, and iron and alkalinity were remarkably low except in two strata: the one with black water, and the one at the top of the anoxic zone. It was suggested that both types of stratification were caused by a high rate of sulfide production in the metalimnion. The relatively high temperature there (as compared to the hypolimnion) and the presumably higher concentrations of organic matter and ammonia, resulting from fish food and fish wastes, account for this high rate of sulfide production. Because of sharp oxygen stratification, 2 carbonate-forming processes, photosynthesis and sulfate reduction, occurred in close proximity to each other. In especially calm weather, vertical density currents of stratification. If the second type of stratification could be produced at will, it might be used to improve the quality of strip mine lake water. (Humphreys-ISWS) W79-07747

NUTRIENT BUDGET ANALYSIS FOR REND LAKE IN ILLINOIS, Illinois State Water Survey, Peoria. Water Quality, Section. For primary bibliographic entry see Field 5A. W79-07748

SPATIAL VARIABILITY AND UNCERTAINTY IN GROUNDWATER FLOW PARAMETERS: A GEOSTATISTICAL APPROACH, Ecole Nationale Supérieure des Mines de Paris, Fontainebleau (France). Center for Geological Information. J. P. Delhomme. Water Resources Research, Vol. 15, No. 2, p 269-280, April 1979. 13 fig, 1 tab, 20 ref.

Descriptors: *Groundwater, *Transmissivity, *Model studies, Mathematical models, Groundwater movement, Distribution patterns, Spatial distribution, Variability, Aquifers, Infiltration, Statistics, Statistical models, Hydrogeology.

A geostatistical approach was proposed for characterizing the uncertainty about the transmissivity field of an aquifer and analyzing its effect on predicted head values. A new methodology was developed which couples conditional simulation and groundwater flow modeling. Conditional simulation was used for generating different two-dimensional transmissivity fields that all have the same spatial variability as the true field and are consistent with the measured T values at well locations. Two case studies were presented in order to illustrate the method, and conclusions were drawn for future investigation. (Sims-ISWS) W79-07766

21. Water In Plants

AN INTRODUCTION TO WISCONSIN WETLANDS - PLANTS, HYDROLOGY, AND SOILS, Geological Survey, Madison, WI. Water Resources Div. For primary bibliographic entry see Field 2G. W79-07766

THE COASTLINE, Saint Catharine's Coll., Cambridge (England). Dept. of Zoology. For primary bibliographic entry see Field 2L. W79-07718

EXISTING STATE AND LOCAL WETLAND SURVEYS (1965-1975). VOLUME II: NARRATIVE, Martel Labs., Inc., Baltimore, MD. For primary bibliographic entry see Field 7B. W79-07726

TRACE AND TOXIC METAL UPTAKE BY MARSH PLANTS AS AFFECTED BY EH, PH, AND SALINITY, Louisiana State Univ., Baton Rouge. Center for Wetlands Resources. For primary bibliographic entry see Field 2K. W79-07727

THE NATURAL RESOURCES OF THE NIPOMO DUNES AND WETLANDS. REPORT NUMBER 15 ON CALIFORNIA COASTAL WETLANDS, California State Dept. of Fish and Game, Sacramento. For primary bibliographic entry see Field 2L. W79-07730

THE NATURAL RESOURCES OF MUGU LAGOON. REPORT NUMBER 17 ON CALIFORNIA COASTAL WETLANDS, California Univ., Santa Barbara. Marine Science Inst. For primary bibliographic entry see Field 2L. W79-07732

THE NATURAL RESOURCES OF ANAHEIM BAY-HUNTINGTON HARBOUR. REPORT NUMBER 18 ON CALIFORNIA COASTAL WETLANDS, California State Dept. of Fish and Game, Sacramento. For primary bibliographic entry see Field 2L. W79-07733

NUTRIENT DYNAMICS OF FRESHWATER RIVERINE MARSHES AND THE ROLE OF EMERGENT MACROPHYTES, Oak Ridge National Lab., TN. For primary bibliographic entry see Field 2K. W79-07734

NUTRIENT RELATIONSHIPS IN THE DETRITUS OF A TROPICAL SWAMP, Makerere Univ., Kampala (Uganda). Dept. of Botany. For primary bibliographic entry see Field 2K. W79-07736

VEGETATION OF THE ATLANTIC COASTAL RIDGE OF PALM BEACH COUNTY, FLORIDA, Florida Atlantic Univ., Boca Raton, Dept. of Biological Sciences. D. R. Richardson. Florida Scientist, Vol. 40, No. 4, p 281-330, Fall 1977. 7 fig, 1 tab, 68 ref.

Descriptors: *Coastal plains, *Vegetation, *Distribution patterns, Wetlands, Florida, Drainage, Drainage effects, Succession.

Pre-drainage vegetational patterns were mapped for the Atlantic Coastal Ridge of Palm Beach County. A detailed analysis of vegetational changes regarding secondary succession was made by selecting specific areas throughout the overall study region. These areas were described by documenting community changes with regard to species composition and community location. A checklist of the vascular flora was made for each selected area. Using the entire coastal strip vegetation maps and specific study sites, generalizations were made regarding plant succession in the major plant communities: Beach, Coastal Strand, Tropical Hammock, Low Hammock, Scrub, Pine latwoods, Wet and Dry Prairies, Mangroves, Swamps, and Freshwater Marshes. Pre- and post-drainage historical and hydrological information was correlated with geological history in order to show how the physical and biological factors affect vegetation. (Steiner-Mass) W79-07737

FOREST SITES, BOG PROCESSES, AND PEATLAND TYPES IN THE GLACIAL LAKE AGASSIZ REGION, MINNESOTA

Lake States Forest Experiment Station, St. Paul, MN. For primary bibliographic entry see Field 2H. W79-07739

BIOLOGICAL PRODUCTION AND NUTRIENT STUDIES OF LAKE CHAMPLAIN, Vermont Univ., Burlington. Dept. of Zoology. E. B. Henson, and M. Potash. Prepared for the International Joint Commission, International Champlain-Richelieu Board, August 1977. 58 p, 6 fig, 17 tab, 38 ref.

Descriptors: *Lake Champlain, *Water levels, *Marsh plants, *Marsh management, Water level fluctuations, Wetlands, Marshes, Freshwater marshes, Nutrients, Nitrogen, Aquatic animals, Reservoir management, Zooplankton, Aquatic plants.

An evaluation was made of the ecological significance of the distribution and abundance of higher plants, algae, zooplankton, and large invertebrates and of the dynamics of the basic nutrients entering, being cycled, and leaving a Lake Champlain wetland. For best growing conditions, water levels should be maintained at about 98.4 feet from late May through June and should not go below 97.4 feet. From July through the remainder of the growing season, the water level should not be reduced below 95.8 feet with 95.1 feet as an absolute minimum. This level permits lateral movement of water through the emergent zone, thus providing needed nutrients, and also maintains an ample submergent-floating zone within the wetland. It is the submergent zone which supports the greatest densities of macroinvertebrates, used for food by fish. Lake levels maintained below 95.1 feet during the winter will serve to kill off much of the aquatic vegetation and cause increased decomposition in the spring and summer, and releasing a greater amount of nutrients into the lake. (Steiner-Mass) W79-07741

EFFECTS OF SPRING WATER LEVELS ON THE REPRODUCTION OF UPPER RICHELIEU AND MISSISSQUOI BAY: NORTHERN PIKE (ESOX LUCIUS L.), Quebec Univ., Montreal (Canada). Dept. of Biology. P. Dumont, and R. Fortin. Prepared for International Joint Commission, International Champlain-Richelieu Board, August 1977. 105 p, 18 fig, 18 tab, 29 ref.

Descriptors: Lake Champlain, *Water levels, *Pikes, *Spawning, Water level fluctuations, Fish management, Lakes, Fish, Fish reproduction, Aquatic habitats, Reservoir management.

Upper Richelieu and Mississquoi Bay floodplain and wetland areas were classified in terms of northern pike spawning and early development potential. All four potential spawning areas begin to be inundated at lake level 98.5 feet and are productive at 100 feet. Good fry production also seems to be related to relatively stable water level conditions for 30-40 days after the lake reaches 98.5 feet and to a gradual drawdown from the peak. If regulation is decided upon, a predictive model based upon air temperature profiles, precipitation, etc., should be elaborated from the historical data available for Lake Champlain. Also, measures should be taken in order to protect all high potential spawning areas from drainage and land fill for development. (Steiner-Mass) W79-07742

LAKE CHAMPLAIN FISHERIES INVESTIGATION: UNITED STATES WATERS, New York State Dept. of Environmental Conservation, Albany. Prepared for the International Joint Commission, International Champlain-Richelieu Board, August 1977 229 p, 11 fig, 5 tab, 211 ref, 7 append.

Descriptors: *Fish reproduction, *Water levels, *Freshwater marshes, *Pike, *Lake Champlain, Wetlands, Spawning, Marshes, Fish management, Lakes, Fish, Reservoir management, Aquatic habitat.

Field 2—WATER CYCLE

Group 21—Water in Plants

Healthy northern pike populations exist throughout the Lake Champlain wetlands but tend to be more dominant in the low gradient wetlands located near the northern portions of the lake. Flooded terrestrial vegetation such as grasses and grass-brush-tree combinations and aquatic emergents appeared as the preferred substrate for spawning. Water levels above 30.0 during the spawning period were the minimum levels required for access to and flooding of vegetative types necessary for egg deposition. If lake level regulation is implemented, inundation of this habitat for a duration of 40-50 days at least once every three years would potentially insure egg and fry survival. Dropping of water levels to avoid flooding during the critical egg and spawning period would have an adverse effect on northern pike production. Reduction of lake elevations from 31.0 to 29.5 m would eliminate approximately 42% of the 37,500 mapped wetlands now existing. (Steiner-Mass)

W79-07743

IRRIGATED CORN YIELD RESPONSE TO WATER.

Southwestern Great Plains Research Center, Bushland, TX.
J. T. Musick, and D. A. Dusek.
Paper No. 78-2557, Presented at the 1978 Winter Meeting of the American Society of Agricultural Engineers, December 18-20, 1978, Chicago, Illinois. 26 p, 8 fig, 3 tab, 16 ref. ASAE, St. Joseph, Michigan.

Descriptors: *Irrigation efficiency, Crop response, Moisture deficit, Evapotranspiration, Moisture stress, *Corn, Water requirements, Yield equations, Growth stages.

Corn grain yield response to water deficits and seasonal evapotranspiration-yield relationships were determined during a 3-yr study in the Southern High Plains. Sensitivity of yields and water-use efficiencies to plant-water stress indicated that limited irrigation should not be practiced in the high-evaporative demand climate. (Skogerboe-Colorado State)

W79-07793

EVALUATION OF CROP WATER STRESS UNDER LIMITED IRRIGATION.

Science and Education Administration, Fort Collins, CO. Agricultural Research.
D. Heermann, and H. Duke.
Paper No. 78-2556, Presented at the 1978 Winter Meeting of the American Society of Agricultural Engineers, December 18-20, 1978, Chicago, Illinois. 5 p, 8 fig, 8 ref. ASAE, St. Joseph, Michigan.

Descriptors: *Moisture stress, Moisture deficit, *Sprinkler irrigation, Soil moisture, Yield equations, Corn, Growth stages.

Limited water application plots were established under 2 center pivot systems planted to corn. Stress was quantified by measuring water applied, soil water, canopy temperatures and plant water potentials. Yield reductions were linearly related to applied water and average canopy temperature differences between control and stressed plots. (Skogerboe-Colorado State)

W79-07892

2J. Erosion and Sedimentation

IDENTIFICATION OF SUSPENDED SEDIMENT SOURCES BY MEANS OF MAGNETIC MEASUREMENTS: SOME PRELIMINARY RESULTS.

Liverpool Univ. (England). Dept. of Geography. For primary bibliographic entry see Field 5B.

W79-07533

MODEL FOR SUSPENDED SEDIMENT TRANSPORT.

Waterloopkundig Lab., Delft (Netherlands).
P. M. J. Kerssens, A. Prins, and L. C. van Rijn.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY3, p 461-

476, Proceedings Paper 14574, May 1979. 12 fig, 14 ref, 2 append.

Descriptors: *Mathematical models, *Diffusion, *Sedimentation, Sediment transport, Estuaries, Suspended load, Dredging, Diffusion, Hydraulics, Model studies, Rivers, Equations, River morphology, River geometry, Diffusion-convection equation, Sediment diffusion.

A mathematical model for suspended sediment transport was described. The model enables the investigation of certain effects of river works or geometrical changes, or both, in a river or estuary by morphological computations. The model is based on the two-dimensional diffusion-convection equation. This equation describes the distribution of the sediment concentrations in a two-dimensional flow field by diffusion and convection. For the local velocities in the vertical, the logarithmic distribution was used, while for the sediment diffusion coefficient a new expression was applied. The diffusion-convection equation was solved by an implicit numerical method using a coordinate transformation, while the influence of the diffusion coefficient on the adaptation of the transport in the case of an overcapacity of sediment was presented. A dimensionless graph of the adaptation length of a uniform concentration vertical was given. The application of the model for tidal flow was described, and for such conditions a prototype verification and a sensitivity analysis were given. The model is limited to situations with relatively small changes in lateral direction and nongraded bed. (Lee-ISWS)

W79-07537

COMPARTMENTED SEDIMENT TRAP.

Massachusetts Univ., Amherst. Dept. of Civil Engineering.
P. J. Murphy, and M. I. Amin.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY3, Proceedings Paper 14577, p 489-500, May 1979. 9 fig, 1 tab, 9 ref, 2 append.

Descriptors: *Bed load, *Sediments, *Sediment transport, Trap efficiency, Instrumentation, Streambeds, Measurements, Hydraulics, Equipment, Rivers, Streams, On-site investigations, Mathematical studies, Particle size, Compartmented sediment trap.

A method for measuring sediment transport was presented. The measurement device is a portable, compartmented, bottom trap that is operated by burying the trap in the stream bed, waiting until the natural bedforms are reestablished, and then opening the trap during a time interval sufficient to collect a large number of moving particles. The sections of the trap allow the calculation of the fractions of the sediment that jump various lengths as they move along the bed. The jump-length distribution permits the direct calculation of the efficiency of the trap for the various grain sizes of the moving sediment. The compartmented trap was field tested in a sand-bottomed creek

W79-07538

DISCRETE DYNAMIC MODEL OF WATERSHED SEDIMENT YIELD.

Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India).
T. C. Sharma, and W. T. Dickinson.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY3, Proceedings Paper 14592, p 555-571, May 1979. 6 fig, 10 tab, 11 ref, 1 append.

Descriptors: *Sediment yield, *Watersheds (Basins), *Model studies, *Mathematical models, Rainfall, Runoff, Suspended solids, Sediments, Bed load, Regression analysis, Statistics, Statistical models, Erosion, Soil erosion, Pollutants, Path of pollutants, Streams, Streamflow, Sedimentation.

The watershed fluvial system was hypothesized as a lumped system with runoff rate (log-transformed) as input and sediment yield rate (log-transformed) as output on a discrete time basis. The effects of

errors in sampling, data reduction, discretizing, etc., of input and output sequences were simulated by another linear system to which input is a white noise. A first-order dynamic model with 5 parameters was demonstrated to provide an adequate model of monthly runoff-sediment yield process. A second-order dynamic model with 7 parameters adequately models the daily runoff sediment yield process. The noise component was found to be a white noise sequence in both cases, explaining 10% to 19% of the variance in the monthly sediment yields and 3% to 5% of the variance in the daily sediment yields. A linear linkage model explains 81% to 90% of the variance in the monthly sediment yields and 95% to 97% of the variance in the daily sediment yields. (Sims-ISWS)

W79-07539

THE TRANSPORT AND RESUSPENSION OF SEDIMENTS IN A SHALLOW LAKE.

Aeronautical Research Associates of Princeton, Inc., NJ.
For primary bibliographic entry see Field 2H.

W79-07541

SEDIMENT LOADS IN THE AMAZON RIVER.

Geological Survey, Denver, CO. Water Resources Div.
R. H. Meade, C. F. Nordin, Jr., W. F. Curtis, F. M. Costa Rodrigues, and C. M. do Vale.
Nature, Vol. 278, p 161-163, 8 March 1979. 3 fig, 1 tab, 9 ref.

Descriptors: *Sediment transport, *Sediment yield, *Suspended load, *Rivers, *Fluvial sediments, Peru, Brazil, *Amazon River, Rio Negro, Rio Madeira.

In late May and early June 1977, suspended-sediment transport rates in the Amazon mainstem ranged from 1.4 to 1.7 x 10 to the 6th power metric tons per day in lower Peru and upper Brazil to 4.7 x 10 to the 6th power metric tons per day at Obidos in lower Brazil. Combining these data with data collected earlier allows us to calculate a new estimate of 8 to 9 x 10 to the 8th power metric tons for the mean annual suspended-sediment discharge at Obidos. (Woodard-USGS)

W79-07710

THE COASTLINE.

Saint Catharine's Coll., Cambridge (England). Dept. of Zoology.
For primary bibliographic entry see Field 2L.

W79-07718

MUDDY FORESHORES.

Nature Conservancy Council, Hampshire (England).
For primary bibliographic entry see Field 2L.

W79-07720

EFFECTS OF CHANNEL ENLARGEMENT BY RIVER ICE PROCESSES ON BANKFULL DISCHARGE IN ALBERTA, CANADA.

Calgary Univ. (Alberta). Dept. of Geography.
For primary bibliographic entry see Field 2E.

W79-07756

USE OF SPECIFIC CONDUCTANCE AND CONTACT TIME RELATIONS FOR SEPARATING FLOW COMPONENTS IN STORM RUNOFF.

New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 2B.

W79-07764

SEDIMENT TRAPS IN CHANNELS—DESIGN PROCEDURES AND PERFORMANCE.

Soil Conservation Service, East Lansing, MI.
G. R. Konwinski.
Paper No. 78-2561, Presented at the 1978 Winter Meeting of the American Society of Agricultural Engineers, December 18-20, 1978, Chicago, Illinois. 6 p. 2 fig. ASAE, St. Joseph, Michigan.

Descriptors: *Channel efficiency, Bed flow, Design

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W79-07804

NATIONAL CANNON ATTENTION FUSED OR General Ac For primary W79-07889

SEDIMENT RETURN RESERVATION 1976 IRRIGATION Geological sources Div L. M. Nelson Geological 42 p, 5 fig.

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CHEMICAL STREAM BRITISH COLUMBIA FORESTRY M. C. Felt Water Res 258, April

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Chemical Processes—Group 2K

Descriptors: *Sediment control, Stream erosion, *Channel erosion, Stream stabilization, Trap efficiency, Bed load, Energy dissipation, Channel flow, Design data.

The design and maintenance of sediment traps to control a stream's energy play a key role in ensuring uniform cross-sectional area in trapezoidal channels. It was suggested that the bedload and the upland must be carefully analyzed to determine the critical energy level which is the first step in the design of a successful in-channel sediment trap. The procedure provided design data needed to proportion the sediment trap to trap bedload sediments by reducing flow velocity through the trap. (Skogerboe-Colorado State) W79-07804

NATIONAL WATER QUALITY GOALS CANNOT BE ATTAINED WITHOUT MORE ATTENTION TO POLLUTION FROM DIFFUSED OR 'NONPOINT' SOURCES. General Accounting Office, Washington, DC. For primary bibliographic entry see Field 2E. W79-07889

SEDIMENT TRANSPORT BY IRRIGATION RETURN FLOWS, ON THE YAKIMA INDIAN RESERVATION, WASHINGTON 1975 AND 1976 IRRIGATION SEASONS. Geological Survey, Tacoma, WA. Water Resources Div. L. M. Nelson. Geological Survey open-file report 78-947, 1979. 42 p, 5 fig, 4 tab, 9 ref.

Descriptors: *Sediment transport, *Irrigation water, *Runoff, *Sediment yield, *Discharge(Water), Data collections, Turbidity, Temperature, *Yakim Indian Reservation(Wash).

As determined from data collected at 10 sites on the Yakima Indian Reservation, Wash., during the 1975 and 1976 irrigation seasons (April-September), seasonal sediment discharges in irrigation return flows ranged from 11,000 tons from Marion Drain and Satus Drain 302 to 400 tons from Coulee Drain. There was little variation between the sediment discharges of the 1975 and 1976 irrigation seasons except those from Satus Drain 302. Due to the lack of natural runoff during those seasons, no distinction could be made between sediment discharges from irrigated and nonirrigated areas. No significant or usable relationships were found between suspended-sediment concentration and concurrent water turbidity or discharges. (Woodard-USGS) W79-07953

2K. Chemical Processes

CHEMICAL CHARACTERISTICS OF SMALL STREAMS NEAR HANEY IN SOUTHWESTERN BRITISH COLUMBIA. British Columbia Univ., Vancouver. Faculty of Forestry. M. C. Feller, and J. P. Kimmins. Water Resources Research, Vol. 15, No. 2, p 247-258, April 1979. 4 fig, 6 tab, 64 ref.

Descriptors: *Water chemistry, *Forest watersheds, *Water quality, *Canada, Forests, Streams, Streamflow, Chemicals, Nutrients, Sampling, Chemical analysis, Storm runoff, Temperature, Water temperature, Sediments, Suspended solids, Evapotranspiration, Water balance, Chemistry, *British Columbia.

The hydrological, thermal, and chemical characteristics of two small streams flowing through relatively undisturbed, low-elevation mountain watersheds in southwestern British Columbia were investigated. All observations and chemical analyses of ecosystems were consistent with the hypothesis that stormflow originated mainly from flow of water through soil macrochannels to groundwater and thence to streams. Water budgets indicated unmeasured groundwater losses. The streams exhibited annual chemical cycles for most param-

eters, with maximum values in late summer and early autumn and minimum values in winter and early spring. Nitrate concentrations displayed no consistent seasonal variation, whereas potassium and sulphate concentrations were relatively uniform throughout the year. Most chemical parameters decreased with increasing discharge, whereas dissolved oxygen concentrations increased. Potassium concentrations exhibited some increases and some decreases, and chloride, nitrate, and sulphate concentrations were generally not significantly related to discharge. Concentration-discharge relationships were used to infer the origin of stormflow water. Differences in the chemistry of the two very similar streams have important ramifications for the design of watershed nutrient studies. Nutrient budgets were very similar to those of other watersheds in humid temperate regions, with net losses of calcium, sodium, magnesium, potassium, chloride, and sulphur. Nitrogen and phosphorus exports in dissolved or particulate organic form were not measured. Based on dissolved inorganic measurements, nitrogen was accumulated, while any gains or losses of phosphorus were extremely small. (Sims-ISWS) W79-07540

ARSENIC IN STREAMS, STREAM SEDIMENTS, AND GROUND WATER, FAIRBANKS AREA, ALASKA. Alaska Univ., Fairbanks. Inst. of Water Resources. For primary bibliographic entry see Field 5B. W79-07563

TEMPERATURE AND PH AS LIMITING FACTORS IN LOSS OF NITRATE FROM SATURATED ATLANTIC COASTAL PLAIN SOILS. North Carolina State Univ. at Raleigh. Dept. of Soil Science. J. W. Gilliam, and R. P. Gambrell. Journal of Environmental Quality, Vol. 7, No. 4, p 526-532, October-December, 1978. 5 fig, 2 tab, 35 ref. OWR A-083-NC (4), 14-34-0001-7070.

Descriptors: *Nitrates, Reduction(Chemical), *Denitrification, Nitrogen, Groundwater, Atlantic Coastal Plain.

Nitrate reduction rates under water-saturated conditions were determined for two acid Atlantic Coastal Plain topsoils and their acid subsoils at 5, 15, and 25°C. Nitrate reduction readily occurred in subsoils even at pH values of 4.5 when an energy source was added. It was concluded that the acid pH values which commonly occur in Atlantic Coastal Plain soils are not a serious limiting factor in NO₃(-) reduction. It was also concluded that the temperatures of 5 to 15°C which exist in the shallow groundwater of the Atlantic Coastal Plain soils during much of the winter limits the rate of NO₃(-) reduction and nitrate reduction can occur in these soils at 5°C but the rate is relatively slow and is highly dependent upon the amount of available C. A significant amount of NO₃(-) reduction was expected during the winter in poorly drained soils which contain relatively high organic matter contents. (Skogerboe-Colorado State) W79-07564

TRACE AND TOXIC METAL UPTAKE BY MARSH PLANTS AS AFFECTED BY EH, PH, AND SALINITY. Louisiana State Univ., Baton Rouge. Center for Wetlands Resources. D. W. Patrick, Jr. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A050 914. Price codes: A07 in paper copy, A01 in microfiche. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi Technical Report D-77-40, December 1977. 124 p, 58 tab, 75 ref.

Descriptors: *Marsh plants, *Metals, *Plant growth substances, Grasses, Salinity, Hydrogen ion concentration, Copper, Lead, Plant growth, Toxins, Biochemistry, Trace elements.

Reasonably successful methods were developed for growing salt marsh plants under conditions of controlled pH, redox potential, and salinity to de-

termine the effects of these physiochemical conditions in the rooting medium on trace and toxic metal availability to plants. Plant cadmium content responded more to change in the physiochemical environment of the rooting medium than did other metals studied. The cadmium content of above-ground was consistently and substantially increased with an increase in oxidation conditions in all species. Maximum cadmium content occurred under acid, oxidizing conditions except for one species in which an oxidized, weakly alkaline environment was favorable. An increase in soil oxidation-reduction conditions increased plant lead content, but this was attributed to a redox potential mediated effect on soil pH. Zinc content was found to increase with increasing oxidation conditions. There was little effect of either pH or oxidation-reduction conditions on the copper content of the species studied. (Steiner-Mass) W79-07727

NUTRIENT DYNAMICS OF FRESHWATER RIVERINE MARSHES AND THE ROLE OF EMERGENT MACROPHYTES. Oak Ridge National Lab., TN. J. M. Klopatek.

Available from the National Technical Information Service, Springfield, VA 22161 as CONF 770248-1, Price codes: A03 in paper copy, A01 in microfiche. 1977. 30 p, 9 fig, 5 tab, 78 ref.

Descriptors: *Freshwater marsh, *Cycling nutrients, *Rooted aquatic plants, *Marsh plants, Wisconsin, Wetlands, Aquatic environment, Soil-water-plant relationships, Aquatic plants, Drawdown, Nutrients, Phosphorus, Potassium, Nitrogen, Calcium, Magnesium, Bullrushes, Cattails, Willow trees.

Inundated and anaerobic soils of a freshwater riverine marsh show significant seasonal variations in available P and K and exchangeable Ca and Mg. Based primarily on investigations in Wisconsin, the role of emergent macrophytes within the marsh nutrient cycle is described. Concentrations of N, P, K, Ca, and Mg follow predictable trends over the growing season. However, the accumulation of these elements in the below and aboveground structures is shown to yield a more complete picture of the functional role of emergent macrophytes. Regression analyses showed nutrient uptake by the macrophytes was significantly correlated to total soil N and available P. Significant correlations were not shown for the other elements and is explained based upon their mobility and the possibility of luxury uptake. Models of the flow of nutrients in a Scirpus fluvialis stand are depicted. The effects of a marsh drawdown on the nutrient cycle are also discussed as well as the nutrient dynamics of Salix interior, a typical riverine community shrub. (Bollinger-Mass) W79-07734

NUTRIENT RELATIONSHIPS IN THE DETRITUS OF A TROPICAL SWAMP. Makerere Univ., Kampala (Uganda). Dept. of Botany. J. J. Gaudet. Archives Hydrobiologia, Vol. 78, No. 2, p 213-239, August 1976. 8 fig, 13 tab, 32 ref, 1 append.

Descriptors: *Swamp, *Detritus, *Cycling nutrients, Africa, Tropic, Wetlands, Sedimentation, Leaching, Streamflow, Waste assimilation capacity, Water analyses, Water chemistry, Nutrients, Nitrogen, Phosphorus, Potassium, Sodium, Calcium, Magnesium, Iron, Manganese, Chloride, Fluoride, Sulphur.

The various components in a papyrus swamp (*Cyperus papyrus* L.) are defined and illustrated using a swamp in Uganda as an example. The components including inputs and outputs were analyzed for N, P, K, Na, Ca, Mg, Fe, Mn, S, Cl, and F. Mineral elements can be: (1) immobilized by incorporation into plant material, (2) returned to the mat water by rain leaching, elution or decomposition, (3) or exported in the particulate material which becomes peat and sludge. However, all nutrients entering the swamp are eventually trapped in the bottom as sludge. Thus, papyrus swamps might be

Field 2—WATER CYCLE

Group 2K—Chemical Processes

better visualized as large holding tanks or septic tanks (rather than filters) in which a large amount of autochthonous organic matter is produced and settled out. The fate of nutrients in the detritus components thus make these components most important in nutrient cycling in these African swamps. (Bollinger-Mass)
W79-07736

MAP SHOWING GENERAL QUALITY OF GROUND WATER IN THE KAIPAROWITS COAL-BASIN AREA, UTAH.
Geological Survey, Salt Lake City, UT. Water Resources Div.
D. Price.
Available from Branch of Distribution, USGS Box 25286, Fed. Ctr. Denver CO 80225 price \$1.50. Geological Survey Miscellaneous Investigations Series Map I-1033-A, 1977. 1 sheet.

Descriptors: *Water quality, *Maps, *Ground-water, *Water wells, *Springs, Aquifers, Salinity, Utah, *Kaiparowits coal-basin area.

This is one of a series of maps that describe the geology and related natural resources in the Kaiparowits coal-basin area. Chemical analyses of water from about 40 widely scattered springs, 20 coal-exploration holes on the Kaiparowits Plateau, and 7 water wells in the vicinity of the communities of Escalante and Glen Canyon were used to compile this map. All the water samples were from depths of less than 1,000 feet. Water-quality data were also available from a number of petroleum wells and exploration holes more than 5,000 feet deep. Ground water in most parts of the Kaiparowits coal-basin area ranges from fresh to slightly saline. In general, the fresh waters are of the calcium bicarbonate type, and the saline water are of the sodium sulfate type. The available chemical analyses indicate that the ground water is generally freshest throughout the headwater areas of the Escalante River, along Cottonwood and Hackberry Canyons, and in the immediate vicinity of Lake Powell. In these areas, the springs sampled commonly contained less than 500 mg/L of dissolved solids. The ground water is generally most highly saline along the southern margin of the Kaiparowits Plateau and in the northeast corner of the study area. (Woodard-USGS)
W79-07737

GROUND-WATER DATA FOR MICHIGAN, 1977.
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W79-07947

2L. Estuaries

TWO-DIMENSIONAL FLOW FIELD OF MULTIPORT DIFFUSER.
Georgia Inst. of Tech., Atlanta. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W79-07535

MODEL FOR SUSPENDED SEDIMENT TRANSPORT.
Waterlooplekondig Lab., Delft (Netherlands).
For primary bibliographic entry see Field 2J.
W79-07537

THE COASTLINE.
John Wiley and Sons, New York, R. S. K. Barnes (Ed.), 1977. 356 p, 99 fig, 27 tab, 721 ref.

Descriptors: *Coasts, *Wetlands, *Shores, *Land management, Salt marshes, Estuaries, Coastal marshes, Coastal plains, Marsh management, Shore protection, Drainage.

This book has been divided into a series of sections, each covering one fairly uniform group of habitats—sandy foreshores, rocky cliffs, salt marshes, estuaries, etc. The common structural

plan of the chapters is: first, a summary of the fundamental ecological and geomorphological processes operating in the environment in question; second, the special features of the environment in terms of ecology and characteristic pressures; third, methods of study; fourth, educational, scientific, recreational, or economic uses of the environment; and fifth, recommended conservation and management policies, including international case studies of success or failure studies. General introductory and concluding chapters are included to place the individual habitats in a wider perspective. (See W79-07718 thru W79-07722) (Steiner-Mass)
W79-07717

THE COASTLINE.
Saint Catharine's Coll., Cambridge (England). Dept. of Zoology.
R. S. K. Barnes.
In the Coastline, p 3-27, 1977. Barnes, R. S. K. (ed.). John Wiley and Sons, New York.

Descriptors: *Coasts, *Salt marshes, *Accretion, Wetlands, Coastal marshes, Coastal plains, Marsh management, Shores, Shore protection, Land management, Erosion.

The position of a coastline can be considered as the result of the operation of three independent factors: continental drift, relative land-sea level, and the local characteristics of the rate of erosion or accretion resulting from subaerial, fluvial, or marine processes. Taking a coastline as a whole, erosion is occurring along a much greater length than is accretion. Accretion mainly occurs in the comparatively quiet waters of estuaries, semi-enclosed bays, and natural harbors. The effect of organisms in promoting accretion is large. Without salt-marsh plants, there would be little natural land reclamation and without dune grasses there would be few dune coastal sand dunes protecting the hinterland from tidal inundation. Change in the vertical height of a marsh surface (brought about by accretion) will affect the frequency of tidal cover and therefore the accretion rate. As a marsh increases in height, the accretion rate will first accelerate as the plant cover becomes more complete and comparatively bushy species succeed smaller ones, but it will decrease when tidal cover becomes infrequent. The other major activity determining the shape and position of the land-water boundary is the behavior of man, particularly in his roles as a reclamer of land and a protector of coastlines. (See also W79-07717) (Steiner-Mass)
W79-07718

LAGOONS.
Ferrara Univ. (Italy). Inst. of Zoology and General Biology.
G. Colombo.
In the Coastline, p 63-81, 1977. Barnes, R. S. K. (ed.). John Wiley and Sons, New York.

Descriptors: *Lagoons, *Preservation, *Lake morphometry, Bays, Wetlands, Development, Conservation, Distribution, Land use, Land reclamation.

Lagoons are shallow bodies of brackish or sea water partially separated from an adjacent coastal sea by barriers of sand or shingle, which only leave narrow openings through which sea water can flow. In general, lagoons are associated with coastlines which have experienced or are experiencing change in the relative land-sea level. A lagoon will evolve either towards total isolation behind a complete sediment barrier, and thence from a coastal pond to swamp and marsh, or into a coastal bay again after erosion of the barrier. Besides the natural evolutionary trends, human activities often affect the structure of lagoons, primarily by hydraulic works, but also by land-reclamation schemes and through changes in the inland watershed. A lagoon is a comparatively simple system and has less homeostatic controls than most other systems; it is therefore comparatively easy to disturb, although it is not too difficult to preserve it in a moderately good condition. In many cases, ecological and hydrological investigation of a lagoon before specific projects are initiated will allow estimates to be made of the likely future evolution of the system and of its susceptibility to deteriorative changes. (See also W79-07717) (Steiner-Mass)

W79-07719

MUDDY FORESHORES.
Nature Conservancy Council, Hampshire (England).
C. R. Tubbs.
In the Coastline, p 83-92, 1977. Barnes, R. S. K. (ed.). John Wiley and Sons, New York.

Descriptors: *Mud flats, *Marsh management, *Shores, Coasts, Wetlands, Preservation, Conservation, Shore protection, Land management, Sediments, Mud, Mud-water interfaces, Tidal effects.

Mud flats are formed by the deposition of fine inorganic material and organic debris in particulate form, which has been held in suspension in the sea or in estuaries. Deposition tends to occur where the turbulence of the sea is most abated and the gradient of the underlying land is slight. In sheltered situations the deposits accumulate to form extensive, level or gently sloping expanses drained by networks of deeply incised channels, some formed by the flood tide and some by the ebb. The process of accretion over level expanses of mud leads naturally to the development of salt marshes, notably where the silt content is high and there is minimal tidal scour. The rapid spread of Spartina marsh since the 1870's has involved a substantial reduction in the total mud flat resource of north-west Europe and this in turn has greatly reduced the areas available to waders and waterfowl as feeding grounds. The reclamation of mud flats for grazing and arable land has occurred widely in the past. Today there is a likelihood of a significant proportion of the remaining mud land resource becoming lost to industry, water storage, and sewage effluent. (See also W79-07717) (Steiner-Mass)
W79-07720

SALT-MARSHES.
Delta Inst. of Hydrobiological Research, Yerseke (Netherlands).
W. G. Beeftink.
In the Coastline, p 93-121, 1977. Barnes, R. S. K. (ed.). John Wiley and Sons, New York.

Descriptors: *Salt marshes, *Marsh management, *Land reclamation, Wetlands, Marshes, Coastal marshes, Tidal marshes, Coasts, Drainage effects, Land use, Grazing, Sewage effluent, Geomorphology, Hydrogeology, Water pollution.

In temperate regions, salt marshes are found in and around river mouths, bays, Wadden areas, lagoons, and on coastal plains protected by sand- and shingle-spits. During marsh genesis, sedimentation of clay and silt takes place especially in the basins whilst coarser particles are deposited on the creek banks. The most common marsh use is grazing—usually by sheep, cows, and horses. Although mostly limited to the higher marshes and coastal dune-slacks, grazing may take up vast areas. Grazing includes selective cutting and removal of plant parts, local manuring, and trampling of the vegetation. The latter also leads to compaction of the topsoil, and, more intensified, to destruction of the turf-layer. Drainage of marshes is also another form of land reclamation. It results in a lowering of the water table and thus in changes in habitat, flora, and fauna. Transversing with ditches is harmful to the geomorphological development, for the natural watercourses may lose their function. Embankment is one of the most serious impacts on salt marshes. In industrialized areas, marshes are threatened by a complex array of man-made detritus, litter, and chemical substances derived from agricultural wastes, fertilizer or trash, urban sewage, and industrial effluents. (See also W79-07717) (Steiner-Mass)
W79-07721

ESTUARIES.
University Coll. of Swansea (Wales). Dept. of Botany.
A. Nelson-Smith.
In: The Coastline, p 123-146, 1977. Barnes, R. S. K. (ed.). John Wiley and Sons, New York.

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Descriptors: *Estuaries, *Water pollution effects, *Management, Primary productivity, Water pollution, Sewage effluents, Organic matter, Oil wastes, Pesticide residues, Wastes, Chemical wastes.

The outstanding feature of estuaries is the high productivity which results from the constant supply of nutrients to a sheltered but dynamic habitat. Estuaries and tidal marshes are regarded as amongst the most fertile natural areas in the world—being up to seven times as productive as a typical wheat field and 20 times more than the open sea. Primary production probably lies in the region of 500 g of organic matter per square meter per annum. Physical pollution in estuaries often exaggerate conditions which are already present to some extent. Particulate wastes create turbidity and may damage gills when suspended, or blanket the bottom and may smother plants and sessile animals when settled. Organic waste decomposition may deplete the oxygen supply. Large discharges of sewage and industrial effluent may represent a sizable addition of fresh water. Oil pollution may depress photosynthesis in plants and bring about the faulty development of animal larvae, deter the more sensitive or delicate amongst mobile animals, and weaken those which are sedentary. (See also W79-07717) (Steiner-Mass) W79-07722

PETROLEUM INDUSTRY IN THE DELAWARE ESTUARY,
Academy of Natural Sciences of Philadelphia, PA. R. Patrick, and W. Whipple.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 962, Price codes: A19 in paper copy, A01 in microfiche. January 1977. 440 p.

Descriptors: *Oil industry, *Toxicity, *Delaware River, Oil wastes, Estuaries, Delaware, Industry wastes, Oily water, Shellfish, Economic costs, Fish, Marine animals.

A comprehensive evaluation was made of all of the sources of petroleum in the Delaware Estuary, including the finding that urban runoff and other unrecorded sources constitute a major part of the total land. Investigations of toxicity of petroleum and its products and derivatives to fish, shellfish, and other organisms have revealed that toxicity to most, but not all, immature organisms is greater than that to adults, that petroleum on sediments is much more toxic to oysters than petroleum dissolved in the water column, and chronic and life cycle studies show very much greater toxicity than the acute bioassay tests which are usually relied upon. Ultraviolet irradiation of No. 2 fuel oil and Iranian crude greatly increases their toxicity. The tracing of effects of a major spill indicates that mechanisms of transport may involve sediment-resuspension relationships which greatly modify relationships derived from previous hydrodynamic transport modeling. Economic, social, and institutional aspects are also covered. (Steiner-Mass) W79-07725

TRACE AND TOXIC METAL UPTAKE BY MARSH PLANTS AS AFFECTED BY EH, PH, AND SALINITY,
Louisiana State Univ., Baton Rouge. Center for Wetlands Resources.
For primary bibliographic entry see Field 2K. W79-07727

NATURAL RESOURCES OF COASTAL WETLANDS IN NORTHERN SANTA BARBARA COUNTY,
San Diego State Univ., CA. Center for Regional Environmental Studies.
C. R. Mahrdt, T. A. Oberbauer, J. P. Rieger, J. R. Verfaillie, and B. M. Browning.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 994, Price codes: A06 in paper copy, A01 in microfiche. Prepared for Fish and Wildlife Service, Washington, D.C., Office of Biological Services, Coastal Wetland Series No. 14, May 1976. 99 p, 12 fig, 1 tab, 45 ref, 7 append.

Descriptors: *Coastal marshes, *Natural resources, *Management, *Ecology, *Assessments, *California, Habitats, Ecosystems, Wetlands, Aquatic habitats, Estuaries, Estuarine environment, Tidal marshes, Land management, Land resources, Land use, Evaluation, Wildlife, Amphibians, Reptiles, Mammals, Birds, Fish, Invertebrates, Vegetation.

A one-year ecological assessment of Vandenberg Air Force Base was made to obtain baseline data on southern California coastal natural resource systems. Five major wetland systems are contained within the 35-mile coastline. Descriptions of the areas and their resources are given along with uses of the resources. Problems and conflicts of use are identified. Present management of the area is evaluated and recommendations made that will protect and enhance the natural resources of the coastal wetlands of northern Santa Barbara County. (Bollinger-Mass) W79-07728

THE NATURAL RESOURCES OF CARPINTERIA MARSH, THEIR STATUS AND FUTURE. REPORT NUMBER 13 ON CALIFORNIA COASTAL WETLANDS,
California Univ., Santa Barbara. Marine Science Inst.
K. B. MacDonald.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 993, Price codes: A06 in paper copy, A01 in microfiche. Prepared for Fish and Wildlife Service, Washington, D.C., Office of Biological Services, March 1976. 69 p, 11 fig, 1 tab, 41 ref.

Descriptors: *Marsh management, *Natural resources, *Wildlife habitat, Marshes, *California, Resource development, Land use, Planning, Water pollution, Coastal marshes, Aquatic habitats, Wetlands, Carpinteria Marsh.

The natural resources of Carpinteria Marsh are documented and the uses that those resources receive are outlined. The problems and conflicts that affect the resources are enumerated and measures are recommended that will protect and enhance the marsh and its resources. It is intended as a guide for citizens, planners, and administrators. (Steiner-Mass) W79-07729

THE NATURAL RESOURCES OF THE NIPOMO DUNES AND WETLANDS. REPORT NUMBER 15 ON CALIFORNIA COASTAL WETLANDS,
California State Dept. of Fish and Game, Sacramento.
K. A. Smith, J. W. Speth, and B. M. Browning.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 995, Price codes: A07 in paper copy, A01 in microfiche. Prepared for Fish and Wildlife Service, Washington, D.C., Office of Biological Services, June 1976. 106 p, 9 fig, 86 ref, 6 append.

Descriptors: *Coastal marshes, *Nipomo dunes, *Conservation, Wetlands, Salt marshes, Dunes, Lagoons, *California, Marshes, Natural resources, Marsh management, Land use.

Documented are the natural resources of an 18-square mile section of the coastal wetlands and dunes in southern San Luis Obispo and northern Santa Barbara counties. Also identified are the uses those resources receive, the problems affecting them, and recommendations for their conservation. The report is intended as a guide for planners, administrators, and all others concerned with the conservation of the area. (Steiner-Mass) W79-07730

THE NATURAL RESOURCES OF MUGU LAGOON. REPORT NUMBER 17 ON CALIFORNIA COASTAL WETLANDS,
California Univ., Santa Barbara. Marine Science Inst.
K. B. MacDonald.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 997,

Price codes: A09 in paper copy, A01 in microfiche. Prepared for Fish and Wildlife Service, Office of Biological Sciences, Washington, D.C., June, 1976. 119 p, 10 fig, 108 ref, 9 append.

Descriptors: *Wetlands, *California, *Marsh management, Lagoons, Natural resources, Land use, Water pollution, Conservation, Coastal marshes, Mugu Lagoon.

The purpose of this report is to document the natural resources of Mugu Lagoon, describe the uses that those resources receive, enumerate the problems that affect them, and recommend measures that will maintain and enhance the wetland. It is intended as a guide to those responsible for resource maintenance of the Lagoon as well as to provide information to those interested in the status and future of the lagoon. Existing and potential problems include: the restriction of tidal flow in the western lagoon arm by existing and/or planned roadways, possible overuse of the site by scientists and disruption of the natural lagoon community by introduced species. Other potential problems that may affect the future of the wetlands largely relate to off-site developments. These problems can be grouped into four categories: water pollution, sedimentation and flood control problems related to Calleguas Creek watershed; increasing urbanization of the agricultural lands surrounding the lagoons; increasing pressure for public recreational access; and a lack of coordinated management efforts. (Steiner-Mass) W79-07732

THE NATURAL RESOURCES OF ANAHEIM BAY—HUNTINGTON HARBOUR. REPORT NUMBER 18 ON CALIFORNIA COASTAL WETLANDS,
California State Dept. of Fish and Game, Sacramento.
J. W. Speth, B. M. Browning, and K. A. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 998, Price codes: A07 in paper copy, A01 in microfiche. Prepared for Fish and Wildlife Service, Washington, D.C., Office of Biological Services, August 1976. 103 p, 9 fig, 3 tab, 57 ref, 9 append.

Descriptors: *Marshes, *Anaheim Bay, *Marsh management, Wetlands, Salt marshes, Natural resources, Management, Land use, Industry, Planning, Water pollution, Dredging, Conservation, Wildlife habitat, Coasts.

All of the area's wetlands are in public ownership and thereby relatively protected from further developments. However, the indirect impact of development and other disturbances within the drainage area is a primary threat. To preserve and protect the remaining wetlands, and to help re-establish some of the wetland system, it is recommended that: dredging and filling except for harbor maintenance and wildlife habitat improvement, be prohibited, and lands adjacent to the eastern and northern boundaries of the wildlife refuge be designated for future addition to the refuge. A program of marsh restoration be instituted to allow tidal waters to flow unrestricted over all lands capable of being flooded within the station boundaries, the western island of Sunset Aquatic Regional Park be dedicated in its entirety to fish and wildlife use, Aeration devices be constructed in strategic locations of Huntington Harbour to assure survival of marine life during periods of low dissolved oxygen levels, and the existing problem of floating trash entering the Anaheim Bay marsh be investigated and a workable solution be determined and implemented. (Steiner-Mass) W79-07733

VEGETATION OF THE ATLANTIC COASTAL RIDGE OF PALM BEACH COUNTY, FLORIDA,
Florida Atlantic Univ., Boca Raton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2I. W79-07737

HYDROCHEMICAL EVIDENCE OF SEA WATER INTRUSION ALONG THE MAN-

Field 2—WATER CYCLE

Group 2L—Estuaries

GROL-CHORWAD COAST OF SAURASHTRA, GUJARAT,
Physical Research Lab., Ahmedabad (India).
B. I. Desai, S. K. Gupta, M. V. Shah, and S. C. Sharma.
Hydrological Sciences Bulletin, Vol. 24, No. 1, p 71-82, March 1979. 6 fig, 3 tab, 11 ref.

Descriptors: *Saline water intrusion, *Coasts, *Hydrogeology, *Water quality, Sea water, Salinity, Groundwater, Aquifers, On-site investigations, Chemical properties, Stratigraphy, Conductivity, Calcium, Sodium, On-site data collections, Foreign research, *India, *Gujarat State (India).

The rapid increase in the salinity of groundwater in the Mangrol-Chorwad area of coastal Saurashtra has been reported during the last decade. The geohydrological and chemical data of the principal aquifers in the region were examined with a view to ascertaining the cause of the increasing salinity in the groundwater of the region. It was shown that the field data are consistent with a simplified model in which limited amounts of sea water enter the limestone aquifer and the Na^+ from the mixed solution exchanges with the Ca^{2+} in the aquifer matrix through the base exchange phenomenon. (Humphreys-ISWS)
W79-07752

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

HIGH FLUX PBI REVERSE OSMOSIS MEMBRANES FOR DESALINATION AND WATER REUSE,
Celanese Research Co., Summit, NJ.
M. Tan, and H. J. Davis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 285, Price codes: A04 in paper copy, A01 in microfiche. Final Report, November 1978. 53 p, 15 fig, 16 tab. OWRT (No. 7527) (1), 14-34-0001-7527.

Descriptors: *Reverse osmosis, *Permeable membranes, Membranes processes, Desalination, Plastics, Polybenzimidazole.

High flux, high rejection flat polybenzimidazole (PBI) reverse osmosis membranes were prepared. Membrane film casting and processing parameters were first identified and optimized in small-scale laboratory film casting trials. On the basis of these thickness results, membranes measuring 12 in. by 36 in. and 2.5 mils in thickness were prepared and evaluated in long-term testing at 600 psi and 400 psi with non-chlorinated and chlorinated salt solutions. Two prototype spiral wound modules were fabricated for demonstration purposes. Membrane samples were tested in high pressure test cells against 5000 ppm salt solutions. In long-term testing, a decline in flux was observed, presumably the result of pressure induced compaction. Salt rejection remained high or improved slightly with time. In long-term testing against salt solutions containing 10 ppm chlorine, reduced water flux was observed after 300 hours. Salt rejection remained well over 90%. The flux decline was attributed, in part, to membrane fouling and compaction.
W79-07571

3B. Water Yield Improvement

PROJECT SKYWATER: FISCAL YEARS 1975-78 REPORT.
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
Progress Report March 1979. 177 p, 15 fig, 12 ref, 4 append.

Descriptors: *Weather modification, *Cloud seeding, *Artificial precipitation, *Meteorology, Forecasting, Instrumentation, Environmental effects, Ecology, Social impact, Cloud physics, Hydrology, Ecosystems, Rainfall, Rainfall-runoff relation-

ships, Model studies, Water resources development, Colorado River Basin, Orography, Contracts, Projects, Research and development.

Research conducted during the fiscal years 1975-1978 under the Bureau of Reclamation's precipitation management program is summarized. During this period the project was characterized by increasingly intensive efforts to reduce scientific uncertainty about the way in which precipitation develops and how science might influence the process beneficially. Project and contract summaries are presented for the Colorado River Basin Pilot Project, the High Plains Cooperative Program, the Sierra Cooperative Pilot Project, and the Colorado River Basin Program which is in preliminary planning. Contracts devoted to general orographic studies are summarized. The equipment developed in support of general atmospheric research, but not connected with any particular project, is described. Summaries are presented of several Project Skywater in-house investigations which explored the problems and concepts relevant to precipitation enhancement technology. (Davison-IPA)
W79-07514

MINIMIZING THE SALT BURDEN OF IRRIGATION DRAINAGE WATER IN THE PECOS VALLEY OF NEW MEXICO,
New Mexico State Univ., Las Cruces. Dept. of Agronomy.
G. A. O'Connor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 599, Price codes: A03 in paper copy, A01 in microfiche. New Mexico Water Research Institute Report No. 105, 1979, 41 p, 10 fig, 7 tab, 21 ref. OWRT A-056-NMEX(2), 14-34-0001-7066.

Descriptors: *Irrigation practices, *Management, *Leaching, Salt balance, Drainage, Soil management, Salts, Leachate, Pecos River Valley, New Mexico.

The purpose was to evaluate the potential of minimized leaching management techniques under Pecos Valley, New Mexico conditions. The objectives were to determine the applicability of the U.S. Salinity Laboratory (USSL) computer model to New Mexico conditions, the effect of minimized leaching on soil and water properties, and the effect of minimized leaching on yield of a crop common to the Pecos Valley. Results show that the Pecos River Valley is ideally suited for minimized leaching management. Minimized leaching reduced the volume of water required for irrigation and also the volume and salt burden of drainage water without detrimentally affecting soil chemical and physical properties or crop yield. The USSL chemical computer model was applicable to Pecos Valley conditions and could be used to make long-term projections of actual field conditions resulting from a minimized leaching management program. (Stockton-N Mex)
W79-07714

MUNICIPAL AND INDUSTRIAL WATER CONSERVATION - THE FEDERAL GOVERNMENT COULD DO MORE,
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 6E.
W79-07881

WATER RESOURCES PLANNING, MANAGEMENT, AND DEVELOPMENT: WHAT ARE THE NATION'S WATER SUPPLY PROBLEMS AND ISSUES,
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 6E.
W79-07882

3C. Use Of Water Of Impaired Quality

OVERCOMING LEGAL AND INSTITUTIONAL BARRIERS TO PLANNED REUSE OF WATER IN THE COLORADO RIVER BASIN,

Denver Research Inst., CO. Industrial Economics Div.
For primary bibliographic entry see Field 6E.
W79-07502

SECURING AGRICULTURAL LAND FOR WASTEWATER IRRIGATION,
Available from the National Technical Information Service, Springfield, VA 22161 as PB-271 776, Price codes: A07 in paper copy, A01 in microfiche. Report, 1977. 135 p, 5 fig, 18 tab, 45 ref, 3 append.

Descriptors: *Return flow, *Irrigation, *Agriculture, *Legal aspects, *Irrigation programs, Waste water disposal, Water reuse, Economics, Evaluation, Reservoir storage, Dairy industry, Application methods, Waste water treatment, Municipal wastes.

An examination of land application of waste water from Petaluma, California, to agricultural land for irrigation included an investigation of methods for obtaining land for waste water disposal. The agricultural irrigation plan was considered to provide wastewater disposal and more efficient use of available water resources, provide long-term preservation of open space, and maintain a dairy industry by supplying locally grown fodder crops. Two potential areas for waste water irrigation were identified to the east and to the southeast of the city. One irrigation plan considered would dispose of treated effluent on fields in the summer and discharge waste water to the Petaluma River in the winter; this procedure would require about 1,400 acres. The second configuration would transfer waste water from the treatment plant to a reservoir where it would be contained in winter and distributed to agricultural fields in summer; this alternative would require about 3,800 acres. The legal interests in the land analyzed included: fee simple, lease, easement, development rights, license, covenant running with the land, contract, option for future needs, and right of first refusal; fee simple, lease, and easement were considered to have the most potential. A series of purchasing and leasing arrangements for securing land for waste water irrigation were then evaluated. (Lisk-FRC)
W79-07796

WATER LAW PROBLEMS OF SOLAR HYDROGEN PRODUCTION,
For primary bibliographic entry see Field 6E.
W79-07901

3D. Conservation In Domestic and Municipal Use

OPTIMUM LAWN WATERING RATES FOR ESTHETICS AND CONSERVATION,
Tudor Engineering Co., Riverton, WY.; and Wyoming Univ., Laramie. Div. of Agricultural Engineering.
J. Barnes, J. Borrelli, and L. Pochop.
Journal of the American Water Works Association, Vol. 71, No. 4, p 204-209, April 1979. 3 fig, 7 tab, 5 ref. OWRT B-035-WYO (4), 14-34-0001-7201.

Descriptors: *Lawns, *Water demand, *Water conservation, *Wyoming, Municipal water, On-site investigations, On-site data collections, Data processing, Evapotranspiration, Soil water, Grasses, Water utilization, Water users, Irrigation, Rates of application, Sprinkling, Sprinkler irrigations, Optimization, *Lawn watering.

It is known that lawn watering comprises a relatively large percentage of municipal water use, but few data exist on individual home lawn water application rates with respect to the esthetic appearance of lawns. This study showed that an esthetically pleasing lawn can be achieved with an average water application rate equal to or less than the seasonal evapotranspiration rate. A homeowner education program was advocated to promote self-rationing during water-short periods. (Sims-ISWS)
W79-07746

REDUCTION AND FLOW GRESS. Environment DC. For primary W79-07785

MUNICIPAL SERVATION COULD DO General Acc For primary W79-07881

3E. Cons

FEASIBILITY COVERY I For primary W79-07794

MUNICIPAL CONSERVATION COULD DO General Acc For primary W79-07881

3F. Cons

LEVEL-BAS FOR CONS Science and AZ. Water L. J. Eric, a Available f Stock No. 2261, April

Descriptors design, *Irr *Irrigation engineering, nance, Hyd Level-basin

Level-basin water is super period of the level area a barrier such a short perie the soil. The thics which used techniz ing of d above 90% of salts, is as well as fl can be utili and labor method incl necessary for the correct leveled is elaborate e quired with principles a forth, and cussed. Gat tices, and n field plans a W79-07506

MINIMIZATI ON I VALLEY O New Mexi Agronomy. For primary W79-07714

IRRIGATE WATER,

Control Of Water On The Surface—Group 4A

REDUCTIONS IN WATER CONSUMPTION AND FLOW OF SEWAGE - REPORT TO CONGRESS.

Environmental Protection Agency, Washington, DC.

For primary bibliographic entry see Field 5F.
W79-07785

MUNICIPAL AND INDUSTRIAL WATER CONSERVATION - THE FEDERAL GOVERNMENT COULD DO MORE.

General Accounting Office, Washington, DC.

For primary bibliographic entry see Field 6E.
W79-07881

3E. Conservation In Industry

FEASIBILITY STUDY OF WASTE WATER RECOVERY IN SHRIMP PROCESSING PLANTS.

For primary bibliographic entry see Field 5D.
W79-07794

MUNICIPAL AND INDUSTRIAL WATER CONSERVATION - THE FEDERAL GOVERNMENT COULD DO MORE.

General Accounting Office, Washington, DC.

For primary bibliographic entry see Field 6E.
W79-07881

3F. Conservation In Agriculture

LEVEL-BASIN IRRIGATION: A METHOD FOR CONSERVING WATER AND LABOR.

Science and Education Administration, Phoenix, AZ.

Water Conservation Lab.

L. J. Eric, and A. R. Dedrick.

Available from U.S.G.P.O., Washington, D.C.,

Stock No. 001-000-03912-1. Farmers Bulletin No.

2261, April 1979. 23, 17 fig, 2 tab.

Descriptors: *Irrigation systems, *Irrigation design, *Irrigation effects, *Irrigation efficiency, *Irrigation operation and maintenance, Irrigation engineering, Surface irrigation, Turnouts, Maintenance, Hydraulic gates, Outlets, Erosion control, Level-basin irrigation.

Level-basin irrigation, a gravity method whereby water is supplied to level soil surfaces over a short period of time, involves application of water to a level area of any shape surrounded by a control barrier such as a dike. Water applied to basins over a short period of time is confined until absorbed by the soil. This type of system has many characteristics which can result in high irrigation efficiency, and offers advantages over other more commonly used techniques. These advantages include: minimizing of deep percolation, application efficiencies above 90% on fine textured soils, natural leaching of salts, is adaptable to automation and to furrows as well as flatbed crops, and large streams of water can be utilized, thereby reducing irrigation time and labor requirements. The limitations of this method include: the difficulty of precision leveling necessary for even water distribution, ascertaining the correct amount of water, the amount of land leveled is limited by the depth of topsoil, and elaborate erosion control measures may be required with the use of a large stream. The basic principles and design in land preparation are set forth, and evaluations of two field trials are discussed. Gates and outlet structures, cultural practices, and management are examined. Diagrams of field plans are provided. (Davison-IPA)
W79-07506

MINIMIZING THE SALT BURDEN OF IRRIGATION DRAINAGE WATER IN THE PECOS VALLEY OF NEW MEXICO.

New Mexico State Univ., Las Cruces. Dept. of Agronomy.

For primary bibliographic entry see Field 3B.
W79-07714

IRRIGATED CORN YIELD RESPONSE TO WATER.

Southwestern Great Plains Research Center, Bushland, TX.

For primary bibliographic entry see Field 2I.
W79-07793

HARVESTING RUNOFF FROM PRECIPITATION ON IRRIGATED LANDS.

Kansas Agricultural Experiment Station, Manhattan.

H. L. Manges, and L. T. Mao.

Paper No. 78-2559, Presented at the 1978 Winter Meeting of the American Society of Agricultural Engineers, December 18-20, 1978, Chicago, Illinois, 10 p. 2 fig, 3 tab, 10 ref, 11 equ. ASAE, St. Joseph, Michigan.

Descriptors: Water harvesting, Runoff, Precipitation(Atmospheric), *Tailwater, Climatic data, Model studies, Evapotranspiration, Water balance, Corn, *Irrigated land.

A tailwater management model was developed to simulate runoff from precipitation on irrigated land. The model was tested for corn using 25 years of climatological data for Garden City, Kansas. Runoff from precipitation pumped onto the field averaged 69 and 39 millimeters annually for two commonly irrigated soils. (Skogerboe-Colorado State)
W79-07890

EVALUATION OF CROP WATER STRESS UNDER LIMITED IRRIGATION.

Science and Education Administration, Fort Collins, CO. Agricultural Research.

For primary bibliographic entry see Field 2I.
W79-07892

RE-EMERGENCE OF A CONTROVERSY: ENFORCING ACREAGE LIMITATION.

For primary bibliographic entry see Field 6E.
W79-07900

ACREAGE AND RESIDENCY LIMITATIONS IN THE IMPERIAL VALLEY: A CASE STUDY IN NATIONAL RECLAMATION POLICY.

For primary bibliographic entry see Field 6E.
W79-07902

DIGITAL CONTROLLER FOR TRICKLE IRRIGATION.

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.

D. D. Fangmeier, and J. D. Busman.

Paper No. 78-2547, Presented at the 1978 Winter Meeting of the American Society of Agricultural Engineers, December 18-20, Palmer House Hotel, Chicago, Illinois, 7 p, 5 fig, 1 tab, 5 ref. ASAE, St. Joseph, Michigan.

Descriptors: *Control systems, Irrigation systems, Water conservation, Electronic equipment, Evaporation, Soil moisture, Moisture tension, Timing, Consumptive use, Application equipment, *Trickle irrigation.

A digital controller was designed using complementary metal oxide semiconductor electronics. The controller uses measured evaporation pan depths and soil moisture tensions to determine the time required to apply the desired quantity of water on a daily basis. Circuit diagrams for major components were presented. (Skogerboe-Colorado State)
W79-07935

ELECTRONIC TIMERS FOR AUTOMATED SURFACE IRRIGATION SYSTEMS.

Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.

H. D. Fisher, A. S. Humpherys, and R. V. Worstell.

Paper No. 78-2544, Presented at the 1978 Winter Meeting of the American Society of Agricultural Engineers, December 18-20, 1978, Chicago, Illinois, 7 p. 3 fig, 5 ref. ASAE, St. Joseph, Michigan.

Descriptors: Surface irrigation, Automatic control, *Control systems, Automation, Timing, Electronic equipment, Instrumentation, *Furrow irrigation, Irrigation systems.

Electronic timers were developed to replace alarm clocks and mechanical timers for semiautomated irrigation structures and valves. Timer-controllers including a micro-processor unit were designed for a field tested with automatic cutback, buried lateral and multiset furrow irrigation systems. (Skogerboe-Colorado State)
W79-07989

A COMPUTER SIMULATION OF SOIL WATER DISTRIBUTION USING THE PULSED DRIP IRRIGATION METHOD AT LOW AND HIGH DISCHARGE RATES ON A SANDY SOIL.

Fruit and Fruit Technology Research Inst., Stellenbosch (South Africa).

F. C. Van Rooyen, P. C. Van Rooyen, and I. Levin.

Water S. A., Vol. 5, No. 1, p 44-56, January 1979. 10 fig, 1 tab, 7 ref.

Descriptors: *Irrigation, *Computer models, *Irrigation effects, *Irrigation efficiency, *Irrigation programs, *Sands, Soil physical properties, Soil water movement, Soil-water-plant relationships, Equations, Mathematical studies, Rates of application, Water spreading, Water distribution, Percolation, Evapotranspiration, Water loss.

A regic sand typical of large areas of the western cape of South Africa was used with a previously verified computer simulation model to study continuous and pulsed drip irrigation rates with respect to vertical and horizontal soil water distribution. Pulsed and continuous irrigation application rates of 1.5 l/hour, 3 l/hour and 9 l/hour were simulated, and a total of 12 l of water was added in each case. All applications were simulated up to a time of 24 hours which included varying time intervals of redistribution after terminating water application. Calculations of soil water distribution were made using a two-dimensional water transport model expanded to include salt. The method for solving the flow equation is presented. The calculations were performed with a FORTRAN program and executed on a Burroughs 7700 computer. The studies showed that the differences between pulsed and continuously applied drip irrigation decreased with increasing discharge rate. For regic sand a 3 l/hour pulsed irrigation yielded the same results as 1.5 l/hour continuously applied with regard to deep percolation losses below 0.6m deep. Differences between pulsed and continuous application were insignificant for this soil at a discharge rate of 9 l/hour. The results showed that a 3 l/hour pulse treatment would be the most suitable where a peak water consumption of 20 to 40 l/plant was determined. (Davison-IPA)
W79-07995

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

A RESERVOIR OPERATING MODEL WITH INORGANIC QUALITY CONSTRAINTS FOR THE TRUCKEE RIVER.

Boyle Engineering Corp., Las Vegas, NV.; and Nevada Univ. System, Las Vegas Desert Research Inst.

T. D. Chiatovich, and J. W. Fordham.

Water Resources Bulletin, Vol. 15, No. 2, p 301-315, April 1979. 4 fig, 1 tab, 5 ref. OWRT (No. 5216) C-6157 (1), 14-31-0001-5216.

Descriptors: *Reservoir operation, *Water quality, *Low-flow augmentation, *Computer models, *Simulation analysis, *Optimization, Evaluation, Feasibility, Standards, Digital computers, Dynamic programming, Reservoir releases, Constraints.

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control Of Water On The Surface

Downstream, Water demand, River basins, Decision making, Systems analysis, Truckee River (Cal Nev), Inorganic, Iterative process, Worth maximization, Costs.

Investigated was low-flow augmentation as a means of meeting inorganic water quality standards for the Truckee River at the California-Nevada state line. A digital inorganic water quality model was combined with a deterministic dynamic reservoir operating model in an iterative process which allowed the optimization of releases subject to selected inorganic water quality constraints as well as downstream demands. The water quality model was a modification of a previously developed chemical water quality model for the Truckee River; estimates of the chemical quality of unregulated inflows or gains to the main river channel were made using regression equations exponentially relating quality and flow. The reservoir operating model was a deterministic dynamic programming model whose objective function was to maximize the total worth of releases considering water quality constraints as well as downstream water demands. Results from model runs with varied flow and river loading data have indicated that flow augmentation may be a feasible and relatively inexpensive way of meeting standards for this system, except in time of severe drought. (Bell Graf-Cornell)
W79-07562

RHYTHMIC SPACING AND ORIGIN OF POOLS AND RIFFLES,

California Univ., Santa Barbara. Dept. of Geological Sciences.
E. A. Keller, and W. N. Melhorn.
Geological Society of America Bulletin, Vol. 89, p 723-730, May 1978. 12 fig, 4 tab, Doc. No. 80509.
OWRT B-089-NC (7) and A-021-IND (6), 14-34-0001-6103.

Descriptors: *Pools, *Riffles, Alluvial stream channels, Stream improvement, Stream stabilization, Meanders, Stream alignment, Fluvial geomorphology.

Quantitative analysis of the spacing of pools in bedrock and alluvial stream channels in California, Indiana, Virginia, and North Carolina suggest that the tendency for streams to meander in the vertical (or third) dimension, as in the horizontal plane, is a fundamental characteristic of many streams that is independent of material type. Simple linear-regression and correlation models reveal that approximately 70% of the variability of the spacing of pools can be explained by the variability of channel width. Analysis of the spacing of 251 pools in eleven streams, utilizing the Kolmogorov-Smirnov goodness of fit test and one-way analysis of variance suggests that the hypothesis that the data from bedrock and alluvial channels are from the same population cannot be rejected at the 0.05 level of significance. Morphologic maps and field observations of stream channels incised in sandstone, limestone, metavolcanic rock, and syenite suggest that although these streams have much in common with alluvial stream channels, there exist considerable differences in certain aspects of channel morphology. This results because bedrock control of morphology locally may be more significant than the effects of general processes that tend to produce rhythmic channel forms such as pools and riffles. However, local controls tend to mask rather than destroy the effects of more general processes that produce the third dimension of meandering streams. (Kiger-North Carolina)
W79-07566

POOLS, RIFFLES, AND CHANNELIZATION,
California Univ., Santa Barbara. Dept. of Geological Sciences.
E. A. Keller.
Environmental Geology, Vol. 2, No. 2, p 119-127, 1978. 6 fig, 3 tab, 22 ref. OWRT B-089-NC (6), 14-34-0001-6103.

Descriptors: *Channel improvement, Geomorphology, Channel morphology, Channelization, Channel erosion, Stream improvement, Stream stabilization, Urban streams.

The addition of regularly spaced deeps (pools) and shallows (riffles) that provide a variety of flow conditions, areal sorting of stream-bed material, cover for wildlife, and a positive aesthetic experience, may be desirable in many channel projects. Such designs will reduce adverse environmental impacts of stream channel modifications. Analysis of variance for pool-to-pool spacing data suggests that there is no significant difference with respect to channel width between pools that form in natural streams and those in streams affected by a variety of human uses. Short of channelization, which changes the channel width, pools and riffles, within limits are not particularly sensitive to environmental stress. Experiments in Gum Branch near Charlotte, North Carolina, support the hypothesis that channel form and process evolve in harmony and that manipulation of cross-channel morphology can influence the development of desired channel processes. Planned manipulation of its channel form induced Gum Branch to develop as desired. Morphologic stability consisting of incipient point bars, pools, and riffles was maintained over a period of high magnitude flood events, only to be degraded later by a wave of sediment derived from upstream construction and stream-bank failures. Thus, environmentally desirable channel morphology in urban streams cannot remain stable if changes in the sediment load or storm-water runoff exceed the limits of the stream's ability to make internal adjustments while maintaining morphologic stability. (Kiger-North Carolina)
W79-07567

CONSERVATION DISTRICTS AND 208 WATER QUALITY MANAGEMENT-NON-POINT SOURCE IDENTIFICATION AND ASSESSMENT, SELECTION OF BEST MANAGEMENT PRACTICES, MANAGEMENT AGENCIES, REGULATORY PROGRAMS,

National Association of Conservation Districts, Washington, DC.
W. B. Davey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-274 411, Price codes: A16 in paper copy, A01 in microfiche. June, 1977, 349 p.

Descriptors: *Environmental control, *Water pollution control, *Water management (Applied), *Regulation, Pollutant identification, Pollution abatement, Erosion, Farm wastes, Federal water pollution control act, Feed lots, Soil conservation.

In its various issuances the federal Environmental Protection Agency (EPA) has recognized that: (1) The basic approach to non-point source pollution control is prevention, and (2) Local entities such as conservation districts should assume a leading role in planning and implementing the programs. Potential conservation district involvement in the preparation and implementation of state and areawide water quality management plans is developed pursuant to Section 208 of the 1972 Federal Water Pollution Control Act Amendments (P.L. 92-500). The non-point pollution source aspects of erosion and sediment control, animal waste management (organics), and irrigation water management (salts) are emphasized. The preparation of management plans is included which EPA indicates should be directed to meet two principal mandates of the Act: (1) The determination of effluent limitations needed to meet applicable water quality standards, including the requirement to at least maintain existing water quality (Section 303); and (2) Development of state and areawide management programs to implement abatement measures for all pollutants sources. (Vloedman-Florida)
W79-07886

NATIONAL WATER QUALITY GOALS CANNOT BE ATTAINED WITHOUT MORE ATTENTION TO POLLUTION FROM DIFFUSED OR 'NONPOINT' SOURCES,
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 2E.
W79-07889

WATER RIGHT LAWS AS THEY AFFECT LAND ACQUISITION AND CONSTRUCTION,

Montana State Univ., Bozeman. Center for Interdisciplinary Studies.

C. C. Bowman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-278 901, Price codes: A03 in paper copy, A01 in microfiche. Report No. NSF-RA-E-74-095, January, 1974, 36 p.

Descriptors: *Water law, *Legislation, *Water rights, *Land development, Regulation, Recreation facilities, Land use, Environmental effects, Regional development, Water users.

This report is divided into three sections. The first presents the customs, laws and federal-state relationships which must be considered when acquiring land and water for recreational facilities. Guidelines are provided for the search to be conducted, to determine the feasibility of water supply and the responsibilities relevant to water and ditch rights. The histories of United States and Montana Water Law are presented including court decisions and existing laws. The second study examines important factors involving water balance, water rights, ditch rights and authority over water, which must be considered before land is purchased, leased or acquired for recreational development. The third part discusses the Gallatin Canyon water rights study. Research objectives include: (1) studying the surface water laws governing water use; (2) determining the existing surface water usage on the Gallatin River above Spanish Creek; (3) determining which governmental agency has the final authority over such waters; (4) determining to necessary studies and procedures required before a recreational area and the supporting commercial facilities can be developed. (Vloedman-Florida)
W79-07891

PROBLEMS AFFECTING USEFULNESS OF THE NATIONAL WATER ASSESSMENT WATER RESOURCES COUNCIL,
General Accounting Office, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-269 257, Price codes: A02 in paper copy, A01 in microfiche. March 23, 1977, 16 p.

Descriptors: *Water resources planning act, *Water requirements, *Water resources, Assessments, Water management, Use rates, Water districts, Data collections, Water users, Regulation, Water demand.

The 1965 Water Resources Planning Act (Act) require the Water Resources Council (Council) to prepare an assessment biennially, or less frequently as the Council may determine of the adequacy of water supplies necessary to meet the requirements in each United States water resource region. Results are presented of a General Accounting Office (GAO) review of the Water Resources Council's efforts to develop a national water assessment pursuant to section 102 of the Act. Problems came to the GAO's attention which raised doubts about the reliability and usefulness of the 1975 assessment. Federal, State and regional agencies were unable to resolve discrepancies in the water data for base year 1975. Steps should be taken to make the final assessment document more responsive to the needs of the intended user agencies. Before undertaking future assessments, the Council should reappraise the project's objectives and the methodology of developing an adequate national water data base. (Vloedman-Florida)
W79-07893

WATER LAW PROBLEMS OF SOLAR HYDROGEN PRODUCTION,
For primary bibliographic entry see Field 6E.
W79-07901

4B. Groundwater Management

CONNECTOR WELL EXPERIMENT TO RECHARGE THE FLORIDIAN AQUIFER, EAST ORANGE COUNTY, FLORIDA,

Geological sources Div. P. W. Bush. Geological 78-73 (open ref.)

Descriptors: *Groundwater, Drilling, T characterist aquifer, *Co

An exper shallow sand the Floridian layer be east Orange on the natu as related to biometric su feet higher Florida ac from the sl through th Continuous shows the averages sli Observation variation w have reach Vertical an parently ca of the san aquifer, rat different li aquifer at t Extensive C County by feasible. N could be c connector experiment from evapo of the conn W79-07705

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General A. For primar W79-07882

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General A. For primar W79-07893

UPDATING WINE IN
For primar W79-07894

GROUNDW ISSUE. GROUND BRASKA
For primar

Geological Survey, Tallahassee, FL. Water Resources Div.
P. W. Bush.
Geological Survey Water-Resources Investigations 78-73 (open-file report), 1979. 40 p, 18 fig, 1 tab, 10 ref.

Descriptors: *Artificial recharge, *Aquifers, *Groundwater recharge, *Orifices, *Aquicludes, Drilling, Transmissivity, Methodology, Aquifer characteristics, Evaluation, Florida, *Floridan aquifer, *Connector wells.

An experimental connector well, screened in the shallow sand aquifer, finished with open hole in the Floridan aquifer, and cased through the confining layer between the two aquifers, was drilled in east Orange County, Florida, to obtain information on the nature and function of the shallow aquifer as related to connector well operation. The potentiometric surface of the shallow aquifer is about 45 feet higher than the potentiometric surface of the Floridan aquifer; hence water flows by gravity from the shallow aquifer to the Floridan aquifer through the well 'connecting' the two aquifers. Continuous flow measurement over 10 months shows the well discharge varies seasonally and averages slightly more than 50 gallons per minute. Observation wells show that, except for seasonal variation water levels within the area of influence have reached steady state within measurable limits. Vertical anisotropy in the shallow aquifer is apparently caused by the shape and (or) arrangement of the sand grains that comprise the shallow aquifer, rather than distinct confining layers of different lithology. Transmissivity of the shallow aquifer at the site is about 600 square feet per day. Extensive dewatering of wetlands in east Orange County by connector wells alone is probably not feasible. Nevertheless, large amounts of water could be channeled to the Floridan aquifer by connector wells. The results of the connector well experiment imply that water is being captured from evapotranspiration and runoff in the vicinity of the connector well. (Woodard-USGS)
W79-07705

FINAL REPORT ON FATE OF METALS APPLIED IN SEWAGE AT LAND WASTEWATER DISPOSAL SITES.
Texas A and M Research Foundation, College Station.
For primary bibliographic entry see Field 5B.
W79-07789

TREATMENT OF PRIMARY SEWAGE EFFLUENT BY RAPID INFILTRATION.
Corps of Engineers, Waltham, MA. New England Div.
For primary bibliographic entry see Field 5D.
W79-07792

WATER RESOURCES PLANNING, MANAGEMENT, AND DEVELOPMENT: WHAT ARE THE NATION'S WATER SUPPLY PROBLEMS AND ISSUES.
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 6E.
W79-07882

PROBLEMS AFFECTING USEFULNESS OF THE NATIONAL WATER ASSESSMENT WATER RESOURCES COUNCIL.
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 4A.
W79-07893

UPDATING GROUNDWATER LAW: NEW WINE IN OLD BOTTLES.
For primary bibliographic entry see Field 6E.
W79-07894

GROUNDWATER - A FILTER FOR A MUDDY ISSUE. (LANDOWNERS' RIGHTS TO GROUNDWATER AS GOVERNED BY THE NEBRASKA PREFERENTIAL USE STATUTE).
For primary bibliographic entry see Field 6E.

W79-07913

MAP SHOWING GENERAL AVAILABILITY OF GROUND WATER IN THE KAIPAROWITS COAL-BASIN AREA, UTAH.
Geological Survey, Salt Lake City, UT. Water Resources Div.
D. Price.
Available from Branch of Distribution, USGS Box 25286, Fed. Ctr. Denver CO 80225 price \$1.50. Geological Survey Miscellaneous Investigations Series Map 1-1033-B, 1977. 1 sheet.

Descriptors: *Groundwater availability, *Hydrogeology, *Maps, *Aquifer characteristics, *Water levels, Water quality, Water yield, Utah, *Kaiparowits coal-basin area.

This is one of a series of maps that describe the geology and related natural resources of the Kaiparowits coal-basin area, Utah. The map is based partly on records of water wells, springs, and coal and petroleum-exploration holes, partly on unpublished reports of field evaluations of prospective stock-water well sites by personnel of the U.S. Geological Survey, and partly on a 6-day field reconnaissance by the writer. Rocks ranging in age from Permian to Holocene are exposed in the Kaiparowits coal-basin area. They consist chiefly of sedimentary rocks—mostly interbedded sandstone, siltstone, shale, conglomerate, and limestone strata—in aggregate a thickness of several thousand feet. The minimum expected yields of individual wells shown on the map assume that the wells are at least 6 inches in diameter; fully penetrate the aquifer; either have no casing, perforated casing, or well screens opposite the aquifer; and are equipped with optimal pumping equipment. The yields shown are those that could be sustained indefinitely by pumping. The ranges of expected depth to ground water shown on the map are based on measured and reported depths of water in wells. Yields of most springs range from less than 1 to about 20 gallons per minute, but several springs discharge more than 100 gallons per minute. Much of the ground water (including springflow) may be too saline to drink. (Woodard-USGS)
W79-07938

USE OF STORM-WATER BASINS FOR ARTIFICIAL RECHARGE WITH RECLAIMED WATER, NASSAU COUNTY, LONG ISLAND, NEW YORK—A HYDRAULIC FEASIBILITY STUDY.
Geological Survey, Syosset, NY. Water Resources Div.
D. A. Aronson, T. E. Reilly, and A. W. Harbaugh.
Long Island Water Resources Bulletin 11, 1979. 57 p, 17 fig, 9 tab, 24 ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Reclaimed water, *Storm runoff, *Infiltration, Model studies, Methodology, Computer models, Simulation analysis, Watersheds(Basins), Control drainage, Water table, *Long Island(NY), Dual-purpose basins.

A survey of 205 storm-water basins in Nassau County, N.Y. shows that 14 of the 50 largest basins would be suitable for dual infiltration of reclaimed water and storm runoff. Each basin would be divided by an earthen partition so that half would be used for storm-water retention, the other half for reclaimed water. The 14 basins together could accommodate 38.6 million gallons per day of reclaimed water at infiltration rates as high as 0.28 feet per hour, which is approximately 20 percent of the basins' theoretical maximum infiltration capacity. However, the basins cannot accommodate the amounts needed to offset the ground-water deficit predicted for the 1990's in Nassau County. The tendency of certain basins to overflow during large-magnitude storms could be reduced by enlarging the basins to accommodate excess runoff, lowering the height of the dividing partition, diverting excess runoff to another basin, or temporarily halting inflow of reclaimed water. The regional water-table rise that would result from artificial recharge at the 14 selected basins would partly offset the decline in the water table and in streamflow caused by sewerage in parts of Nassau and Suffolk Counties. (Woodard-USGS)

W79-07948

CHANGES IN VEGETATION DIVERSITY CAUSED BY ARTIFICIAL RECHARGE.
Geological Survey, Tucson, AZ. Water Resources Div.
T. E. A. van Hylckama.
Vegetatio, Vol. 39, No. 1, p 53-57, 1979. 3 fig, 2 tab, 16 ref.

Descriptors: *Plant groupings, *Artificial recharge, *Ecotypes, *Distribution patterns, *Recharge ponds, Balance of nature, Grasslands, Pre-impoundment, Post-impoundment, *Lubbock(TEX), *Zandvoort(Netherlands), Plant sociology, Plant taxonomy.

Efforts to increase the rate of artificial recharge through basins often necessitates scraping and ditching before and during operations. Such operations can result in more or less drastic changes in vegetation (depending on what was there before), characterized by diminished numbers of species and lowered diversity. Two examples, one from the Netherlands and one from Texas are presented showing how similar treatments cause similar changes in two completely different plant societies. (Woodard-USGS)
W79-07951

MODELLING SUBSURFACE IRRIGATION RETURN FLOW.
Department of the Environment, Ottawa (Ontario). Hydrology Research Div.
S. R. Singh.
In: Hydrology Research Division, Annual Progress Reports and Short Research Notes, 1977-78, p 62-67, 1979. 1 fig, 3 ref. Environment Canada Inland Waters Directorate, Ottawa, Report Series No. 64. HR 76-4.

Descriptors: *Groundwater recharge, *Mathematical models, *Irrigation, Soil-water-plant relationships, Drainage effects, Irrigation methods, Aquifers, Equations, Computer programs, Computer models, Simulation analysis, Subsurface irrigation, Subsurface flow, Groundwater flow.

A study was conducted to (1) develop a mathematical model for predicting groundwater recharge from irrigation taking into account the soil-plant-atmosphere interactions and the methods of irrigation; (2) develop an aquifer simulation model for quantitative analysis of groundwater flow toward the drainage facilities; and (3) validate the models through the use of the soil moisture and groundwater data collected at the Irrigation Experiment Project in Alberta. Models were developed separately for different components and then connected in a computer program. The differential equation of groundwater flow through an inhomogeneous, unconfined, two-dimensional aquifer is presented along with the solution procedure. This solution procedure completes the development of a finite element model for simulating two-dimensional, transient-free surface groundwater flow through actual aquifers. The temporal distribution of subsurface irrigation return flow, subject to different rates of groundwater recharge resulting from sprinkler or surface flooding irrigation, can be predicted with this model. (Davison-IPA)
W79-07958

HYDROGEOLOGY OF IRRIGATION RETURN FLOW.
Department of the Environment, Ottawa (Ontario). Hydrology Research Div.
A. Vandenberg.
In: Hydrology Research Division, Annual Progress Reports and Short Notes, 1977-78, p 68-80, 1979. 4 fig, 3 tab, 2 ref. Environment Canada Inland Waters Directorate, Ottawa, Report Series No. 64. HR 77-1.

Descriptors: *Hydrology, *Irrigation effects, *Hydrogeology, *Groundwater recharge, *Piezometers, Groundwater flow, Measurement, Instrumentation, Testing, On-site tests, Bedrock, Groundwater barriers, Infiltration, Irrigation water, Vauxhall(Alberta, Canada), Oldman

Group 4B—Groundwater Management

During 1977 the first phase of the project to be completed involved the drilling, logging and testing of two 122 m test holes to obtain preliminary information on subsurface geology and groundwater conditions. Seven piezometer nests, each having three piezometers were installed in the test holes. The regional hydrogeology and the geologic setting of the Vauxhall irrigation return flow study area in southeastern Alberta are described. The second phase of the field work included infiltration and limited pump tests on each piezometer. A sand and gravel layer within the surface deposits encountered at all piezometer nest locations appears to be continuous over the area, and occurs at the same distance above the surface of the bedrock. The drillhole information indicates that the bedrock divide lies to the north of the topographic divide. If this is the case, groundwater seepage would tend to be diverted along the surface of the bedrock towards the Oldman River instead of toward the Bow. The estimates of permeability for the strata around the tips of the piezometers are based on the results of both the long-term infiltration and the short-term pumping tests. The permeability values presented are indicative of the relative permeability for the different strata; they are not absolute values. (Davison-IPA)

W79-07959

MONITORING SPAWNING GRAVEL IN MANAGED FORESTED WATERSHEDS, A PROPOSED PROCEDURE,
Corvallis Environmental Research Lab., OR. Ecosystems Modeling and Analysis Branch.
For primary bibliographic entry see Field 5C.
W79-07503

For primary bibliographic entry see Field 2L.
W79-07717

Saint Catharine's Coll., Cambridge (England).
Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W79-07718

For primary bibliographic entry see Field 2L.
W79-07720

Academy of Natural Sciences of Philadelphia, PA.
For primary bibliographic entry see Field 2L.
W79-07725

THE NATURAL RESOURCES OF CARPENTERS MARSH, THEIR STATUS AND FUTURE. REPORT NUMBER 13 ON CALIFORNIA COASTAL WETLANDS, California Univ., Santa Barbara. Marine Science Inst.
For primary bibliographic entry see Field 2L.
W79-07729

**NIPOMO DUNES AND WETLANDS. REPORT
NUMBER 15 ON CALIFORNIA COASTAL
WETLANDS,**
California State Dept. of Fish and Game, Sacra-
mento.
For primary bibliographic entry see Field 2L.
W79-07730

**THE NATURAL RESOURCES OF ANAHEIM
BAY--HUNTINGTON HARBOUR. REPORT
NUMBER 18 ON CALIFORNIA COASTAL
WETLANDS,**
California State Dept. of Fish and Game, Sacra-
mento.
For primary bibliographic entry see Field 2L.
W79-07733

DEVELOPER'S HANDBOOK,
Connecticut Dept. of Environmental Protection,
Hartford. Coastal Area Management Program.
For primary bibliographic entry see Field 6B.
W79-07735

**COAL MINE WATER POLLUTION - LEGAL
AND REGULATORY ISSUES: A SURVEY,**
For primary bibliographic entry see Field 5B.
W79-07887

**WATER RIGHT LAWS AS THEY AFFECT
LAND ACQUISITION AND CONSTRUCTION,**
Montana State Univ., Bozeman. Center for Inter-
disciplinary Studies.
For primary bibliographic entry see Field 4A.
W79-07891

**WATER WAY PRESERVATION: THE WILD
AND SCENIC RIVERS ACT OF 1968,**
For primary bibliographic entry see Field 6E.
W79-07895

HARBOR LINES AND THE PUBLIC TRUST DOCTRINE IN WASHINGTON NAVIGABLE WATERS,
Washington Univ., Seattle. School of Law.
R. W. Johnson, and E. M. Cooney.
Washington Law Review, Vol. 54, No. 2, p 275.
314, 1979.

Descriptors: *Shore protection, *Washington, *Legislation, Regulation, Water law, Water management, Water policy, Harbors, Coastal engineering, Zoning.

Since 1971, the Shoreline Management Act has been the dominant legal tool for managing the Washington coastal zone. However, use of state- and local laws to manage navigable fish and salt water below low tide or the low-water line are still controlled by the harbor line system established in the 1889 state constitution. The relationship of the harbor line system to the Shoreline Management Act, to the various federal laws concerned with the coastal zone, and to the public trust doctrine are analyzed. The origin, development, and operation of the system in Washington are described. Federal and state legislation and court opinions concerned with the problem of controlling uses of navigable waters and beds in Washington are surveyed. These laws and decisions have: (1) preserved water surfaces and beds for water-related uses by curbing filling and construction; (2) protected the environmental and aesthetic qualities of these areas; (3) developed priorities for future uses; and (4) established governmental regulatory systems for controlling development and activities. Washington's Harbor Line System and comments on the Seattle central waterfront controversy are also examined. (Vloedman-Florida)

W79-07897

WATER LAW PROBLEMS OF SOLAR HYDROGEN PRODUCTION,
For primary bibliographic entry see Field 6E.
W79-07901

**A FINITE-ELEMENT MODEL OF OVERLAND
AND CHANNEL FLOW FOR ASSESSING THE
HYDROLOGIC IMPACT OF LAND-USE
CHANGE.**
Virginia Polytechnic Inst. and State Univ., Blacks-
burg. Dept. of Agricultural Engineering.
B. B. Ross, D. N. Contractor, and V. O.
Shanholtz.
Journal of Hydrology, Vol. 41, p 11-30, 1979. 7 fig.
4 tab. 30 ref. OWRT A-062-VA (5).

Descriptors: *Land use, *Finite element analysis, Surface flow, Mathematical models, Watersheds, Flood hydrographs, Overland flow, Channel flow.

This report presents a method of determining the hydrologic impact of land-use change on a watershed. With precipitation excess as input, the finite-element technique, utilizing Galerkin's residual method, was used to route mathematically overland and channel flow. The nature of the model allowed land-use changes to be easily incorporated into the model. A hypothetical watershed and an imaginary storm were used to obtain initial flood hydrographs. Several arbitrary land-use changes were then made and their effect upon the response of the watershed system determined.

W79/J7565

**NATIONAL WATER QUALITY GOALS
CANNOT BE ATTAINED WITHOUT MORE
ATTENTION TO POLLUTION FROM DI-
FUSED OR 'NONPOINT' SOURCES,**
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 2E.
W79-07889

CONTROLLING SEDIMENT DAMAGE,
Prince George's County Government, MD.
T. H. Secor.
In: *The Freshwater Potomac, Aquatic Communities and Environmental Stresses. Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978, pp. 174-178, 3 tab. Interstate Commission on the Potomac River Basin, Rockville, MD. Technical Publication 78-2.*

Descriptors: *Sediments control, *Erosion contr. *Water pollution sources, *Water quality standards, Soil types, Suspended solids, Turbidity, Flow rates, Land use, Agriculture, Construction, Soil conservation, Soil management, Rainfall-runoff relationships, Ecology, Soil properties, Soil stabilization, Potomac River basin.

Nonpoint source pollution varies in quantity and quality, is associated with runoff generated by storm events, and comes from diffuse sources. Setting standards for controlling sediment from nonpoint sources is difficult, because the problems involved in setting such standards are complex. The background levels of pollutants in streams and rivers vary from one region to another and from one river to another. Soils in different areas and climates are geologically different, and contribute to different water quality. Total suspended solids (TSS) and turbidity vary with flow rates, land use practices, rainfall intensity, and the effects of TSS and turbidity on aquatics. In accounting for these variabilities, standards must protect the biosphere from harmful concentrations, and should be tailored for each stream segment. Agriculture has traditionally been involved in erosion control, but is still the greatest contributor of sediment in the Potomac basin because it occupies a great portion of the basin. Control measures used by the construction sector in the Maryland-Virginia-Washington, D. C. area include diversion dikes, gravel outlet structures, straw bale barriers, sediment traps, temporary seedlings, and sediment basins, the latter being the most effective. Local ordinances controlling erosion from construction sites have been in effect in the Washington area for many years; other states have adopted mandatory erosion and sediment control programs which have proven to be effective. (Davison-IPA)

W79-07990

Identification Of Pollutants—Group 5A

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

EVALUATING POLLUTION STRESS ON ECOSYSTEMS

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
K. L. Dickson, J. Cairns, Jr., J. R. Clark, and J. H. Rodgers.

In: *The Freshwater Potomac: Aquatic Communities and Environmental Stress*, p 80-83, 1978. 1 fig, 3 tab, 5 ref. Flynn, K. C., and Mason, W. T., Eds.. Interstate Commission on the Potomac River Basin. E-(40-1) 4939.

Descriptors: *Eutrophication, *Water pollution, *Environmental effects, *Ecosystems, Primary productivity, Photosynthesis, Aquatic microorganisms, Periphyton, Biomass, Measurement, Sulfates, Carbon, Aquatic life, Algae, Assay, Laboratory tests, Pollutant identification.

Some approaches to assessing pollutant impacts on ecosystem functions are discussed. Research activities conducted by the Aquatic Ecology Group at Virginia Polytechnic Institute have been confined to the development of methods to measure in situ C14 and S35 uptake by Periphyton (Aufwuchs) and an evaluation and adaptation of methods to measure living biomass of the Periphyton community. Measurements of the primary production of this community were made on natural and artificial substrates. An assay of S35 gave an estimate of the autotrophic versus the heterotrophic biomass of this complex community. The assimilatory sulfate reduction was shown to be linked in the algal components of the Periphyton, and can be distinguished from heterotrophic sulfate uptake by bacteria and fungi. Functional indices, analogous to species diversity indices, were developed as a result of the evaluation of the Periphyton community. Trophic Index values, Functional Trophic values, and the computation of a Viability Index are discussed. It is concluded that a combination of information from functional indices and information on the fauna and flora of a system will provide a better understanding of the biological integrity of the system. (Davison-IPA)
W79-07516

IDENTIFICATION OF SUSPENDED SEDIMENT SOURCES BY MEANS OF MAGNETIC MEASUREMENTS: SOME PRELIMINARY RESULTS

Liverpool Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W79-07533

CHEMICAL CHARACTERISTICS OF SMALL STREAMS NEAR HANEY IN SOUTHWESTERN BRITISH COLUMBIA

British Columbia Univ., Vancouver. Faculty of Forestry.
For primary bibliographic entry see Field 2K.
W79-07540

A FIELD STUDY OF THE RELATIONSHIP BETWEEN HEAVY METAL CONCENTRATIONS IN STREAM WATER AND SELECTED BENTHIC MACROINVERTEBRATE SPECIES

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W79-07570

VOLTAMMETRIC ION SELECTIVE ELECTRODE FOR THE DETERMINATION OF NITRATE

Southern Illinois Univ., Carbondale. Dept. of Chemistry and Biochemistry.
J. A. Cox, and G. R. Litwinski.
Analytical Chemistry, Vol. 51, p 554-556, April 1979. 3 fig, 16 ref. OWRT A-087-ILL(7).

Descriptors: *Nitrates, Chemical analysis, Anion exchange, Electrodes.

A sensor which uses an anion-exchange membrane to enclose a small volume electrolysis cell has been demonstrated to be suitable for nitrate determinations. The three-electrode cell includes a constrained mercury column indicator electrode; filter paper, which is impregnated with a 0.1 M KCl-0.01 M ZrOCl₂ electrolyte, serves as the constraining barrier and as the spacer for the thin-layer electrolysis chamber. The anion-exchange membrane sheath permits transfer of nitrate from the sample into the electrolysis chamber by Donnan dialysis and excludes several species which would otherwise interfere. Controlled potential electrolysis at -1.25 V vs. Ag/AgCl provides the sensing current, the value of which is proportional to the sample concentration of nitrate. As a steady-state current is not developed with the present design, a defined current sampling time is used. Linear response over 3 orders-of-magnitude nitrate concentration is obtained. The detection limit using the current at 8 min. is 6.7×10^{-6} M NO₃.
W79-07586

TESTING THE ENVIRONMENT FOR DISPERSED MUTAGENS: USE OF PLANT BIOCONCENTRATORS COUPLED WITH MICROBIAL MUTAGEN ASSAYS

Massachusetts Univ., Amherst. Dept. of Botany.
W. S. Barnes, and E. J. Klekowski, Jr.
Environmental Health Perspectives, Vol. 27, p 61-67, December, 1978. 1 fig, 71 ref. OWRT B-053-MASS (4), 14-34-0001-6087.

Descriptors: Genetics, *Bioassay, *Ferns, Water pollution effects, Microbiology, Toxins, Plant pathology, Environmental effects, Carcinogens, Mutagens.

Mutagens dispersed in ecosystems are usually in low concentration and episodic in occurrence. The possibility of detecting such dispersed mutagens by utilizing indigenous bioconcentrator organisms coupled with a microbial mutagen assay may offer a useful screening protocol. Body extracts of these bioconcentrators can be suitably fractionated and tested for mutagens with various microbial mutagen assays. The fractions may be tested with a broad range of microbial assays covering numerous genetic end points as well as both with and without mammalian microsomal activation. This kind of environmental screening has an advantage over physicochemical techniques, in that sampling techniques are simpler and a wider chemical spectrum can be screened. There are problems inherent with testing a complex biological extract, however. If a reversion assay is used, the metabolite necessary for growth may be present. Toxins may be introduced, either concentrated from the environment in the same way as the mutagen, or produced by the concentrator itself. Finally, the concentrator may also produce an endogenous mutagen which will give spuriously active extracts. Methods for minimizing some of these difficulties are discussed. (Godfrey-Mass)
W79-07587

SCREENING AQUATIC ECOSYSTEMS FOR MUTAGENS WITH FERN BIOASSAYS

Massachusetts Univ., Amherst. Dept. of Botany.
E. J. Klekowski, Jr.
Environmental Health Perspectives, Vol. 27, p 99-102, December, 1978. 11 ref. OWRT B-053-MASS (5), 14-34-0001-6087.

Descriptors: Genetics, *Bioassay, *Ferns, Water pollution effects, Toxins, Plant pathology, Environmental effects, Carcinogens, Mutagens, *Osmunda regalis*.

Recent research studies on the royal fern, *Osmunda regalis*, have documented a high incidence of post-zygotic mutational damage in a population growing in a river heavily polluted with paper processing wastes, whereas genetic studies of nearby populations in nonpolluted environments failed to detect mutational damage. Intensive genetic and cytogenetic studies of mutation in *O. regalis* indicate that natural populations of homo-

sporous ferns may be useful in situ bioassay systems for monitoring the presence of mutagens in aquatic ecosystems. Since these organisms are long-lived perennials with an ontogenetic system which stores mutational damage, they can be manipulated to give an integrated estimate of mutational damage for specified blocks of time (in units of years). Thus, the fern bioassay may be an inexpensive means of detecting both chronic low dose and episodic high dose inputs of mutagenic pollutants into aquatic ecosystems. The fern mutagen bioassay is based upon the detection of numerous categories of post-zygotic mutation load in natural fern populations. The frequency of sporophytic and embryonic lethals, leaf or root mutations, auxotrophic gametophytic mutations as well as numerous phenotypic alterations of gametophyte morphology can be routinely detected and quantified. In addition, various two-break chromosome aberrations (paracentric inversions, reciprocal translocations and ring chromosomes) can be readily screened for in the spore mother cells of many homosporous ferns. (Godfrey-Mass)
W79-07588

CORRELATIONS BETWEEN DAPHNIA MAGNA AND FATHEAD MINNOW (PIMEPHALES PROMELAS) CHRONIC TOXICITY VALUES FOR SEVERAL CLASSES OF TEST SUBSTANCES

Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
A. W. Maki.
Journal of the Fisheries Research Board of Canada, Vol. 36, p 411-421, 1979. 6 fig, 7 tab, 31 ref.

Descriptors: *Bioassay, *Detergents, *Surfactants, *Daphnia, *Minnows, Methodology, Toxicity, Trophic level, Metals, Polychlorinated biphenyls, Pesticide toxicity, Fecundity, Chlorinated hydrocarbon pesticides, Linear alkylate sulfonates, Standards, Water chemistry.

Chronic toxicity values were developed for *Daphnia magna* with six surfactants and a detergent builder, each selected on the basis of previously existing chronic fish test data. Predictive correlations were examined for testing end points between 21-d *Daphnia* chronics and 1-yr fish chronics to provide a short-term alternative chronic test species while developing toxicity data for an intermediate trophic level species. For the detergent materials tested, a strong correlation ($r=0.98$) exists between *Daphnia* and fish no-effect concentrations. A replacement term, NOEC (no observed effect concentration), is suggested to clarify interpretive ambiguities associated with the definition of the MATC (maximum acceptable toxicant concentration) value. Additional chronic toxicity data from the current literature for these two test species and several test substances representing metals, polychlorinated biphenyl isomers, and pesticide formulations were similarly compared. The relatively short life cycle and 21-d duration of the test, small water volumes, ease in handling, high fecundity, and good correlation of 21-d chronic data with chronic fish toxicity data make *Daphnia* chronic tests an attractive alternative to the conduct of longer term fish tests. (Deal-EIS)
W79-07603

DIELDRIN POLLUTION IN THE RIVER HOLME CATCHMENT, YORKSHIRE

Manchester Univ. (England).
For primary bibliographic entry see Field 5C.
W79-07604

COMPARISON OF TOXINS IN THREE ISOLATES OF GONYAULAX TAMARENSIS (DINOPHYCEAE)

Rhode Island Univ., Kingston.
M. I. Alam, C. P. Hsu, and Y. Shimizu.
Journal of Phycology, Vol. 15, p 106-110, 1979. 3 fig, 1 tab, 19 ref.

Descriptors: *Toxicity, *Red Tide, *Dinoflagellates, *Gonyaulax, *Saxitoxin, Fish toxins, Poisons, Toxins, Chemical properties, Chemical analysis, Massachusetts, Cultures, Bioluminescence, Public

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

health, Falmouth, Orleans, Perch Pond, Mill Ponds.

Toxicity levels and profiles of three isolates of *Gonyaulax tamarens* grown under the same conditions were compared. One isolate was collected from Ipswich, Massachusetts, during the massive red tide of 1972 along the New England coast. The other two isolates were obtained from Perch Pond (Falmouth, Massachusetts) and Mill Pond (Orleans, Massachusetts) located in the southwest and south of Cape Cod, Massachusetts, respectively. All the three cultures produced toxins with variation in their toxicity levels. Toxin contents were highest in the Ipswich isolate, followed in an order by Mill Pond and Perch Pond cultures. Morphological similarity existed between Ipswich and Mill Pond cells, whereas the Perch Pond cells possessed an additional ventral pore on the 1' epithelial plate. (Deal-EIS)
W79-07620

CHANGES IN PHYTOPLANKTON PHYSIOLOGY AND MORPHOLOGY IN RESPONSE TO DISSOLVED NUTRIENTS IN LOUGH NEAGH, N. IRELAND,
Northern Ireland Dept. of Agriculture, Antrim. Freshwater Biological Investigation Unit.
C. E. Gibson, and R. J. Stevens.
Freshwater Biology, Vol. 9, p 105-109, 1979. 2 fig, 10 ref.

Descriptors: *Nutrients, *Metabolism, *Phytoplankton, *Tissue analysis, *Ireland, Cyanophyta, Phosphorus, Carbohydrates, Absorption, Cytological studies, Biochemistry, Chemical analysis, Phosphates.

Cell phosphorus and anthrone-reactive carbohydrate contents were measured over a 6-month period in the phytoplankton of Lough Neagh, N. Ireland. When all the soluble reactive phosphorus had disappeared from the water column, cell phosphorus contents began to decrease, reaching a minimum value of 0.4% ash-free dry weight. At this time, cell carbohydrate contents greatly increased and phosphorus sorption assays showed rapid uptake of orthophosphate. Following a presumed sediment phosphorus release, cell carbohydrate and phosphorus uptake rate decreased greatly and there was a subsequent increase in cell phosphorus content to 1.6% ash-free dry weight. As the cell phosphorus content declined, blue-green algal filaments became progressively shorter. On the basis of these responses it is likely that phosphorus limitation occurred over a 4-week period. (Deal-EIS)
W79-07621

PCBS AND ORGANOCHLORINE INSECTICIDES IN OYSTERS FROM COASTAL LAGOONS OF THE GULF OF MEXICO, MEXICO,
Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Ciencias del Mar y Limnologia.
For primary bibliographic entry see Field 5C.
W79-07630

ENVIRONMENTAL DISTURBANCE AND LIFE HISTORIES: PRINCIPLES AND EXAMPLES,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W79-07636

UPTAKE AND LOSS OF ZINC AND LEAD BY MUSSELS (*MYTILUS EDULIS*) AND RELATIONSHIPS WITH BODY WEIGHT AND REPRODUCTIVE CYCLE,
Australian Atomic Energy Commission Research Establishment, Lucas Heights. Environmental Biology Section.
For primary bibliographic entry see Field 5C.
W79-07646

SOURCES OF HEAVY METAL CONTAMINATION IN A RIVER-LAKE SYSTEM,

Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.
T. A. Jackson.
Environmental Pollution, Vol. 18, p 131-138, 1979. 3 fig, 1 tab, 13 ref.

Descriptors: *Heavy metals, *Lakes, *Bottom sediments, *Wabigoon River (Canada), Mercury, Copper, Zinc, Cadmium, Iron, Path of pollutants, Sediment transport, Industrial wastes, Chemical wastes, Water chemistry, Chemical analysis.

Sediments of the Wabigoon River, Ontario, are polluted with Hg from an industrial source at Dryden. Downstream the river flows first through Clay Lake and then through Ball Lake. Hg, Cu, Zn, Cd and Fe concentrations in sediments of both lakes are correlated with organic C, but Hg content per unit concentration of organic C is higher, and increases more steeply with organic C, in Clay Lake than in Ball Lake; in contrast, the Cu, Zn, Cd, and Fe concentrations per unit concentration of organic C are nearly the same in both lakes. These results substantiate the conclusion that the Hg originated at a point upstream from the lakes and tended to accumulate in Clay Lake on its way downstream, whereas the other metals were leached into the two lakes from diffuse sources in the surrounding terrain. Accumulation of river-borne organic pollutants in Clay Lake was also demonstrated. Application of the methods employed to the general problem of recognising and locating element anomalies is discussed. (Deal-EIS)
W79-07649

BACTERIAL STREAMER GROWTH IN A DISUSED PYRITE MINE,
University Coll. of North Wales, Bangor. Dept. of Biochemistry and Soil Science.
For primary bibliographic entry see Field 5C.
W79-07651

ZINC AND COPPER LEVELS IN BELFAST LOUGH,
Northern Ireland Polytechnic Jordanstown. School of Life Sciences.
For primary bibliographic entry see Field 5C.
W79-07657

APPLICATION OF A NEW BIOASSAY TO SCREEN THE TOXICITY OF POLYCHLORINATED BIPHENYLS ON BLUE-GREEN ALGAE,
Institut fuer Wasserforschung G.m.b.H., Dortmund, (Germany, F.R.).
N. Zullei, and G. Benecke.
Bulletin of Environmental Contamination and Toxicology, Vol. 20, p 786-792, 1978. 6 fig, 1 tab, 9 ref.

Descriptors: *Bioassay, *Polychlorinated biphenyls, *Pesticide toxicity, *Cyanophyta, *Dioxin, Algae, Toxicity, Laboratory tests, Analytical techniques, Chemical analysis, Chlorinated hydrocarbon pesticides, Chlorination, Chromatography.

A new bioassay was applied testing the toxicity of several PCB's and tetrachlorodibenzo-p-dioxin against blue-green algae. The motility of the blue-green algae, as measured by a photoelectric cell, is used as the criterion of the toxicity. Biphenyls with a low degree of chlorination, TCDD, mono-, di-, and trichlorobiphenyls, inhibited the motility of *Phormidium* spec., while higher chlorinated biphenyls had no effect. (Deal-EIS)
W79-07658

INDUCTION OF BENZO (A) PYRENE MONOOXYGENASE IN FISH AND THE SALMONELLA TEST AS A TOOL FOR DETECTING MUTAGENIC/CARCINOGENIC XENOBIOTICS IN THE AQUATIC ENVIRONMENT,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Lab. for Marine Molecular Biology.
For primary bibliographic entry see Field 5C.
W79-07669

CHEMOSENSORY INDUCED BRADYCARDIA IN THE KELP CRAB, *PUGETTIA PRODUCTA* (RANDALL),
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W79-07673

IN VIVO EFFECT ON ATPASE IN CERTAIN TISSUES OF LABEO ROHITA AND SACCOBRANCHUS FOSSILIS, FOLLOWING CHRONIC CHLORDANE INTOXICATION,
D. A. V. Coll., Muzaffarnagar (India). Pollution Relevant Research Lab.
For primary bibliographic entry see Field 5C.
W79-07674

DETECTION OF NAPHTHALENE BY THE BLUE CRAB, *CALLINECTES SAPIDUS*,
National Marine Fisheries Service, Highlands, NJ. Sandy Hook Sport Fisheries Marine Lab.
W. H. Pearson, and B. L. Olla.
Estuaries, Vol. 2, No. 1, p 63-64, 1979. 1 tab, 7 ref.

Descriptors: *Animal behavior, *Crabs, *Chemoreceptors, *Naphthalene, *Callinectes, Organic compounds, Animal physiology, Crustaceans, Aromatic compounds, Toxicity, Pollutant identification, Oil, Oil spills.

Increases in the antennular flicking rate indicated that blue crabs, *Callinectes sapidus*, detected the petroleum hydrocarbon naphthalene. A low incidence of aggressive displays but no food searching or gathering followed naphthalene detection. The results suggest that the chemosensory abilities of decapod crustaceans cover a broader range of substances than previously supposed. (Deal-EIS)
W79-07676

INTERTIDAL ECOLOGY OF THE SEA SHORE NEAR TARAPUR ATOMIC POWER STATION,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
For primary bibliographic entry see Field 5C.
W79-07677

A PORTABLE SUCTION DREDGE FOR QUANTITATIVE SAMPLING IN DIFFICULT SUBSTRATES,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
I. M. Brook.
Estuaries, Vol. 2, No. 1, p 53-56, 1979. 3 fig, 15 ref.

Descriptors: *Sampling, *Research equipment, *Bottom sampling, Sediments, On-site data collections, Dredging, Bottom sediments, Grasses, Benthic flora, Benthic fauna.

A lightweight, portable suction dredge has been used for five bottom types which usually present problems to benthic investigators. Water depth ranged from 0.25m to 5m. By use of a 0.25m² quadrant or using the suction end as a probe with the depth of penetration limited by a collar, quantitative samples were taken in coarse sand, fine flocculent mud, dense turtle grass (*Thalassia testudinum*), sparse turtle grass over coralline rubble (*Porites* sp.) and carbonate rock with an overlay of shell rubble. The samples consisted of the material retained by a collecting bag attached to the suction dredge. None of the commonly used benthic sampling devices could obtain samples at all stations. (Deal-EIS)
W79-07678

A MATHEMATICAL MODEL FOR THE UPTAKE OF HEAVY METALS IN BENTHIC ALGAE,
Central Inst. for Industrial Research, Oslo (Norway).
For primary bibliographic entry see Field 5C.
W79-07680

DISTRIBUTION OF MIREX IN AN EXPERIMENTAL ESTUARINE ECOSYSTEM,

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Identification Of Pollutants—Group 5A

Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5C.
W79-07682

SOME ECOLOGICAL EFFECTS OF THE VENPET - VENOIL COLLISION,
Department of Industries, Sea Point (South Africa). Sea Fisheries Branch.
For primary bibliographic entry see Field 5C.
W79-07684

FACTORS INFLUENCING PH IN LAKE WATER,
Swedish Water and Air Pollution Research Lab., Goteborg (Sweden).
C. Brosset.
Water, Air and Soil Pollution, Vol. 11, No. 1, p 57-62, 1979. 2 fig, 3 tab, 1 ref.

Descriptors: *Acidic water, *Lakes, *Humic acids, *Hydrogen ion concentration, Humus, Acids, Organic matter, Chemical analysis, Water chemistry, Organic acids, Acid-base equilibrium, Analytical techniques.

Using an improved titration technique, Lee and Brosset have established the presence in a number of lake waters of an acid with (k sub a)=0.0003. It is shown that higher concentrations of this acid, which seems to correspond to a functional group of humus, may under certain conditions drastically contribute to the lowering of pH of lake water. In lake water containing no humic acid or humic acid in the concentration 0.0001 equiv/l to the minus first power, pH reduction has been calculated as a function of strong acid deposition. It was found that the ability of lake water to withstand a decrease in pH can be drastically reduced by the presence of higher concentrations of humic acid. (Deal-EIS)
W79-07687

DISTRIBUTION AND FRACTIONATION OF ARSENIC IN SELECTED FRESH WATER LAKE SEDIMENTS,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
P. M. Huang, and W. K. Liaw.
Internationale Revue den Gesamten Hydrobiologie, Vol. 63, No. 4, p 533-543, 1978. 2 fig, 5 tab, 23 ref.

Descriptors: *Sediments, *Lakes, *Lake sediments, *Arsenic, *Apatite, Colloids, Carbonates, Organic matter, Silicates, Particle size, Agricultural runoff, Erosion, Food chains, Water chemistry.

The distribution and nature of the As-bearing components of the sediments of selected fresh water lakes in Saskatchewan, Canada, were studied. The total As contents ranged from 2.7 to 13.2 ppm As and were found to be present in both colloidal and non-colloidal fractions of the lake sediments. The proportion of the As bound to carbonates, organic matter and sesquioxides accounted for 12 to 74% of the total As of the sediments. The remaining As was apparently associated with apatite and silicates. The data indicate that the bulk of As in the lake sediments resides in sesquioxides components and apatite. The release of As from the lake sediments would thus be affected by the stability of these As-bearing components in a series of particle size fractions. Furthermore, based on information on the geographical distribution of As in the lake sediments, land erosion and agricultural runoff appear to be contributing significantly to the As concentration in lake sediments. It is thus suggested that close attention should be paid to land management and soil conservation to prevent further enrichment of As in lake sediments and to curtail the subsequent As contamination of the food chain. (Deal-EIS)
W79-07689

UPTAKE FROM SEAWATER AND CLEARANCE OF P,P'-DDT BY MARINE PLANKTONIC CRUSTACEA,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.

For primary bibliographic entry see Field 5C.
W79-07690

NUTRIENT BUDGET ANALYSIS FOR REND LAKE IN ILLINOIS,
Illinois State Water Survey, Peoria. Water Quality, Section.
V. Kothandaraman, and R. L. Evans.
Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol. 105, No. EE3, Proceedings Paper 14616, p 547-556, June 1979. 3 fig, 4 tab, 11 ref, 1 append.

Descriptors: *Nutrients, *Lakes, *Streams, *Illinois, Algae, Streamflow, Water pollution, Water pollution sources, Sediments, Turbidity, Suspended solids, Phosphorus, Nitrates, Sodium, Potassium, Sampling, On-site investigations, Data processing, *Rend Lake(IL).

A new method for computing long-term average nutrient loads transported to the Rend Lake in southern Illinois by its tributaries was presented. The procedure was adopted from the Geological Survey's flow-duration curve method developed for determining the long-term average sediment loads transported by streams. The nitrogen and phosphorus loads exerted on Rend Lake were found to be excessive. The lake is of recent origin, and, despite the excessive nutrients input, algal counts in the lake are not of bloom proportion. Controlling phosphorus at the point sources will be a major step in arresting the accelerated aging of the lake. (Sims-ISWS)
W79-07748

REMOVING HYDROGEN SULFIDE WITH HYDROGEN PEROXIDE,
National Water Well Association, Wothington, OH.
For primary bibliographic entry see Field 5F.
W79-07762

INVESTIGATION OF THE ORION RESEARCH AMMONIA MONITOR,
Environmental Monitoring and Support Lab., Cincinnati, OH. Instrumentation Development Branch.
For primary bibliographic entry see Field 7B.
W79-07776

AN INDEX OF REFRACTORY ORGANICS,
Connecticut Univ., Storrs. Dept. of Civil Engineering.
T. B. Helfgott, F. L. Hart, and R. G. Bedard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 438, Price codes: A07 in paper copy, A01 in microfiche. Report EPA-600/2-77-174, 1977. 131 p, 2 fig, 13 tab, 49 ref, 4 append.

Descriptors: *Refractivity, *Organic compounds, *Persistence, *Evaluation, *Industrial wastes, Biodegradation, Inhibitors, Waste water treatment, Biochemical oxygen demand, Activated sludge.

Laboratory techniques for, and interpretations of, a Refractory Index were developed to quantitatively assess the persistency of refractory organics. The Refractory Index is then used to evaluate 38 industrial, natural and combined organics. Index values close to 1.0 characterize readily biodegradable; index values close to 0 indicate refractory organics; negative index values indicate inhibitors. The index value coefficient of variation is 13%. A Biological Inhibition Value was developed and used to quantitatively assess those organics found to interfere with biochemical tests used. In some cases, confirmation of the Refractory Index interpretation was performed using a model activated sludge unit and by specific analysis. Correlations between oxygen demand tests and organic parameters (total organic carbon) are presented. Suggestions for required pretreatments of industrial waste waters before allowing discharge into municipal sewage treatment plants are included as an application of the Refractory Index criterion. (Small-FRC)
W79-07784

A REVISION OF EXISTING REGULATIONS OF THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 6E.
W79-07883

CONSERVATION DISTRICTS AND 208 WATER QUALITY MANAGEMENT-NON-POINT SOURCE IDENTIFICATION AND ASSESSMENT, SELECTION OF BEST MANAGEMENT PRACTICES, MANAGEMENT AGENCIES, REGULATORY PROGRAMS,
National Association of Conservation Districts, Washington, DC.
For primary bibliographic entry see Field 4A.
W79-07886

NATIONAL WATER QUALITY GOALS CANNOT BE ATTAINED WITHOUT MORE ATTENTION TO POLLUTION FROM DIFFUSED OR 'NONPOINT' SOURCES,
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 2E.
W79-07889

DEVELOPMENT OF MINI-COMPUTER PROGRAMMING TO AID IN INTERPRETATION OF MASS SPECTRAL DATA,
Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
R. S. Scanlan.
In: 'Environmental Studies, South Texas Outer Continental Shelf, Biology and Chemistry,' Texas University Marine Science Institute, Supplemental Reports to Contract AA550-CT6-17, to the Bureau of Land Management, p 13-1 - 13-68, 1979. 1 tab, 1 ref, 2 append. CC550-CT6-17.

Descriptors: *Texas, *Oil pollution, *Analytical techniques, *Pollutant identification, Baseline studies, Water pollution effects, Resources development, Environmental effects, *Outer Continental Shelf, Petroleum hydrocarbons, South Texas Outer Continental Shelf(STOCS).

A part of the integrated STOCS baseline study is the measurement and characterization of higher molecular weight hydrocarbons by the analytical techniques of combined gas chromatography and mass spectrometry. The combined analysis involves the use of a digital data acquisition and data synthesis system having a 'library' of mass spectra with which unknown mass spectra may be compared to assist in identification. The total system in use at this laboratory is a DuPont Model 21-491 GC-Mass Spectrometer (GC/MS) with a DuPont Model 21-094B data acquisition system. The library associated with this system contains 7054 mass spectra. (Sinha-OEIS)
W79-07924

DEVELOPMENT OF A CHELATING/CO-PRE-CIPITATION PROCEDURE FOR MATRIX-FREE ANALYSIS OF VARIOUS METALS IN ORGANISMS FROM THE SOUTH TEXAS OCS BY ATOMIC ABSORPTION SPECTROPHOTOMETRY,
Texas A and M Univ., College Station. Dept. of Oceanography.
B. J. Presley, and P. N. Boothe.
In: 'Environmental Studies, South Texas Outer Continental Shelf, Biology and Chemistry,' Texas University Marine Science Institute, Supplemental Reports to Contract AA550-CT6-17, to the Bureau of Land Management, p 14-1 - 14-29, 1979. 9 fig, 6 tab, 5 ref. CC550-CT6-17.

Descriptors: *Texas, *Spectrophotometry, *Metals, *Pollutant identification, Water pollution effects, Environmental effects, Heavy metals, Baseline studies, Cadmium, Nickel, Lead, *Outer Continental Shelf, Petroleum hydrocarbons, South Texas Outer Continental Shelf(STOCS).

A procedure is described using ammonium pyrrolidone dithiocarbamate (APDC) for the co-precipitation and preconcentration of trace metals in orga-

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Group 5A—Identification Of Pollutants

nism digests for subsequent determination using flameless atomic absorption spectrophotometry (AAS). The MLR copex procedure described provides greatly increased sensitivity at the expense of increased variability. Therefore, it is a highly sensitive but semi-quantitative procedure for the study of certain trace metals in biological tissues. The method best measures Pb in all sample types, Ni in gill and Cd in liver tissues; and it is least effective in estimating Ni levels in muscle and liver. Application of the procedure to STOCs samples with previously undetectable metal levels generally confirms the low levels of Cd and Ni reported and indicates that Pb levels in these samples are only slightly below the detection limit. (Sinha-OEIS)
W79-07925

ENVIRONMENTAL STUDIES, SOUTH TEXAS OUTER CONTINENTAL SHELF, BIOLOGY AND CHEMISTRY. VOLUME III - APPENDICES A-F.
Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
For primary bibliographic entry see Field 5C.
W79-07927

ENVIRONMENTAL STUDIES, SOUTH TEXAS OUTER CONTINENTAL SHELF, BIOLOGY AND CHEMISTRY. VOLUME IV - APPENDICES G-I.
Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
For primary bibliographic entry see Field 5C.
W79-07928

ENVIRONMENTAL STUDIES, SOUTH TEXAS OUTER CONTINENTAL SHELF, BIOLOGY AND CHEMISTRY. VOLUME V - APPENDICES J-M.
Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
For primary bibliographic entry see Field 5C.
W79-07929

ENVIRONMENTAL STUDIES, SOUTH TEXAS OUTER CONTINENTAL SHELF, BIOLOGY AND CHEMISTRY. VOLUME VI - APPENDICES N-S.
Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
For primary bibliographic entry see Field 5C.
W79-07930

AUTOMATED DETERMINATION OF TIN IN WATER.
Geological Survey, Denver, CO. Water Resources Div.
G. Pyen, and M. Fishman.
Atomic Absorption Newsletter, Vol. 18, No. 1, p 34-36, January-February 1979. 1 fig, 4 tab, 3 ref.

Descriptors: *Water analysis, *Bottom sediments, *Trace elements, *Chemical analysis, *Analytical techniques, Laboratory tests, *Atomic absorption spectrometer, *Tin, Sample preparation.

An automated laboratory flow-through procedure was developed to determine tin in water and streambed materials. Sample solutions for streambed materials are obtained by a standard U.S. Geological Survey extraction procedure. The interferences from most trace elements are eliminated by addition of EDTA. Sodium borohydride is added to the sample stream to form tin hydride which is then stripped from the solution with the aid of nitrogen and decomposed at 850°C in a tube furnace that is in the optical path of an atomic absorption spectrometer. Twenty samples per hour can be analyzed. The detection limits are 1 microgram/L and 0.1 microgram/g for water samples and streambed materials, respectively. (Woodard-USGS)
W79-07950

ARSENIC CONTAMINATION OF GROUND WATER IN THE MARITIMES,

Department of the Environment, Ottawa (Ontario). Hydrology Research Div.
D. J. Bottomley.
In: Hydrology Research Division, Annual Progress Reports and Short Notes, 1977-78, p 83-89, 1979. 3 tab, 2 ref. Environment Canada Inland Waters Directorate, Ottawa, Report Series No. 64. HR 77-2.

Descriptors: *Arsenic compounds, *Water pollution, *Groundwater, *Sampling, *Laboratory tests, Analytical techniques, Spectroscopy, Well data, Well casings, Iron, Manganese, Alkalinity, Sulfates, Silica, Chlorides, Fluorides, Carbon, Organic compounds, Lead, Copper, Zinc, Nickel, Cadmium, Potassium, Strontium, Sodium, Nova Scotia(Canada), New Brunswick(Canada).

Three wells in Nova Scotia were sampled at the well head for major ion and trace element analysis; cation analysis; sulfate, chloride, silica, alkalinity and fluoride determinations; and organic carbon analysis. Atomic absorption spectroscopy was used to analyze As, Fe, Mn, Cu, Pb, Zn, Co, Ni, Cd, Ca, Mg, K, and Sr; sodium was analyzed by flame emission. Manual arsine generation with sodium borohydride was used to analyze arsenic. It was found that the sampling methodology and pumping generation affected the concentrations of arsenic iron, and manganese in each well, and that in large diameter deep wells, a peristaltic pump was unsatisfactory for providing representative samples of arsenic, iron and manganese levels due to its inability to flush adequately the casing contaminants from the well. Concentrations of Cu, Pb, Zn, Co, and Ni were less than 5 micrograms/L, and Cd concentration was less than 1 microgram/L. Data obtained from Harvey, Waverley and Miller Lake samples indicate that most arsenic at Waverley is in the As3+ state, and most of the inorganic arsenic at Harvey and Miller Lake is as As5+ in the form of H2AsO4- or HAsO42-. (Davison-IPA)
W79-07960

MICROBIOLOGICAL STUDIES,
Maryland Univ., College Park. Dept. of Microbiology.
R. R. Colwell, and M. R. Belas.
Interstate Commission on the Potomac River Basin, Rockville, MD. Technical Publication 78-2. In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978. p 9-14, 5 fig, 1 tab, 5 ref.

Descriptors: *Microorganisms, *Aquatic bacteria, *Coliforms, *Water pollution sources, *Potomac River, Analytical techniques, Data collections, Sampling, Monitoring, Water quality, Interstate Commission on the Potomac River Basin.

Data on the microbiology of the Potomac River were gathered from the Interstate Commission on the Potomac River Basin (ICPRB) for the years 1960 through 1975, and from the U. S. Army Corps of Engineers for the years 1950 through 1975 for statistical analysis to determine whether a decline in water quality has occurred as measured by microbiological indices. These data were entered and stored in the University of Maryland UNIVAC 1108 computer where multivariate analysis of variance (MANOVA), regression, and correlation coefficient tests were conducted at the five percent level of significance on the total data set and on selected subsets of the larger data file. Significant differences were observed in the downstream total coliform counts which most likely come from point source pollution entering the River during its down stream flow. Large increases in bacterial numbers were observed at Williamsport, Maryland, as the flow moved downstream. No detectable year to year change in water quality downstream was observed. Differences in yearly grand means of the total coliform counts could be distinguished with a significant increase in bacterial numbers for 1968. Because ICPRB data were limited no conclusions could be made regarding improvement or decline in water quality based on microbiological parameters. From the U. S. Army Corps of Engineers data, a general trend was noted toward increasing number of coliform

bacteria at Great Falls during the 1950 to 1977 period. It is concluded that water quality is decreasing in the Potomac and that measuring and sampling techniques are inadequate for detecting water quality changes. (Davison-IPA)
W79-07963

PHYTOPLANKTON,
Environmental Monitoring and Support Lab., Cincinnati, OH.
C. I. Weber, W. T. Mason, and V. J. Rasin.
Interstate Commission on the Potomac River Basin, Rockville, MD. Technical Publication 78-2. In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978. p 15-24, 10 fig, 3 tab, 19 ref.

Descriptors: *Phytoplankton, *Data collections, *Data storage and retrieval, *Potomac River, Eutrophication, Nutrients, Sampling, Analytical techniques, Zooplankton, Water pollution sources, Water pollution, Water quality.

Systematic sampling of the phytoplankton was carried out at four stations in the Potomac River Basin by the National Water Quality Network from 1958 through 1967. Samples collected on about the first and 15th of each month had volume of 3.6 liters, and were preserved with 36 mg/liter MERTHIOLATE (Copyright). Three types of analyses were performed on each sample at the central laboratory in Cincinnati: (1) Sedgwick-Rafter phytoplankton count, (2) a diatom species count, and (3) a zooplankton count. The basic data on the species and abundance of the plankton are currently stored in the files of the Aquatic Biology section, Environmental Monitoring and Support Laboratory, EPA, Cincinnati, Ohio, and the summary data were coded, machined and entered on line into the Storet system. The total annual mean phytoplankton counts increased with distance downstream from Williamsport, the uppermost station on the river. This indicated favorable growth conditions, such as higher concentrations of dissolved nutrients. The percentage of the total counts exceeding 10,000 units/ml was 2% at Williamsport, 18% at Great Falls, and 37% at Washington. The lower Potomac would be considered highly eutrophic on the basis of total counts. The diversity of the phytoplankton measured as numbers of genera, increased with distance downstream from Williamsport. The dominant genera, increased with distance downstream from Williamsport. The dominant genera indicated significant levels of nutrient enrichment. The plankton genera in the Potomac River are tabulated. It is concluded that the total counts and taxonomic composition of the River are characteristic of surface waters with high concentrations nutrients occurring in waste treatment plant effluents. (Davison-IPA)
W79-07964

ROOTED AQUATIC PLANTS,
Environmental Protection Agency, Washington, DC. Office of Water and Hazardous Materials.
L. Keup, and D. B. Hicks.
Interstate Commission on the Potomac River Basin, Rockville, MD. Technical Publication 78-2. In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978. p 25-28, 1 fig, 3 tab, 4 ref.

Descriptors: *Rooted aquatic plants, *Nutrients, *Nitrogen, *Phosphorus, Eutrophication, Sampling, Standing crop, Potomac River, Monocacy River, Antietam Creek, Conococheague River, South Branch Potomac River, Cacapon River, Shenandoah River.

A study was conducted of the aquatic plants in the upper Potomac River Basin by the EPA Division of Field Investigations to estimate the quantity of phosphorus (P) and organic nitrogen (N) accumulated in rooted plant growth, and to assess the significance of those stored nutrients on the nutrient budget of the River Basin. The study area extended 220 miles upstream from Great Falls to

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the confluence of the Savage River, and included the following tributaries: Monocacy River, Antietam Creek, Conococheague Creek, South Branch Potomac River, Cacapon River, and Shenandoah River. Study results are reported as estimated tons of plants containing P and N in terms of pounds for the upper Potomac River, Antietam Creek, and Conococheague Creek. The Monocacy, South Branch Potomac, Shenandoah, and Cacapon Rivers did not contain sufficient growths of aquatic plants from which standing crop estimates could be made. It is concluded that the rooted aquatic plants in the upper Potomac basin are not a significant factor in the nutrient budget of the lower Potomac River, because the quantities of P and N contained are equivalent to about 40% of the P and N in the waste waters discharged to the upper Potomac River in a single day. (Davison-IPA) W79-07965

BIOLOGICAL INDICES IN WATER QUALITY ASSESSMENT

Versar, Inc., Springfield, VA.
J. R. Freed, and M. W. Slimat.
Interstate Commission on the Potomac River Basin, Rockville, Md. Technical Publication 78-2. In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. D. and Mason, W. T., Eds., 1978. p 76-79, 16 ref.

Descriptors: *Bioindicators, *Water pollution effects, *Water quality, *Chemical analysis, Water analysis, Ecology, Ecosystems, Evaluation, Indicators, Pollutant identification, Federal Water Pollution Control Act Amendments of 1972, Mattawoman Creek(Maryland).

The settlement of litigation between environmental groups and the EPA over whether the assessment of water quality should include biological indices as well as chemical indices required the EPA to develop knowledge on biological means to measure water quality. Advantages of biological assessment methods include: (1) they complement the more frequently used chemical methods; (2) they measure the response of the biotic community; (3) they measure the results of pollution, and therefore are more indicative of the consequences of pollution; and (4) because the biotic community represents 'the results of a summation of the prevailing conditions,' the effects of intermittent or single discharges of pollution can be measured. Various biological indices for assessing water quality are examined. When a study must be confined to a synoptic component of the condition of the whole ecosystem, it is felt that benthic invertebrates are most likely to be the most useful group to be studied. The saprobien system recognizes three major zones indicative of organic pollution. The indicator organism approach, a derivative of the saprobien system, uses organisms classified according to their ability to tolerate organic pollution. Reference station methods compare the characteristics of clean water habitats with polluted habitats. Diversity indices, some of the most widely used tools, characterize communities by the number of species present. An example of the use of biological indices to assess long-term water quality after an oil spill in a tributary of the Potomac River is given. (Davison-IPA) W79-07973

EFFLUENT TOXICITY TESTING, Environmental Protection Agency, Wheeling, WV.

H. R. Preston.
Interstate Commission on the Potomac River Basin, Rockville, Md. Technical Publication 78-2. In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. D. and Mason, W. T., Eds., 1978. p 84-89, 2 fig, 1 tab, 4 ref.

Descriptors: *Pollutant identification, *Effluents, *Toxicity, *Water pollution, *Industrial wastes, *Municipal wastes, Analytical techniques, Water analysis, Water quality, Technology, Equipment, Minnows, Liquid wastes, Construction materials, Laboratory tests.

The basic needs and requirements for conducting valid toxicity tests on municipal and industrial effluents are discussed. A mobile laboratory developed by the aquatic biologists of EPA Region III is capable of performing static and continuous flow toxicity tests near effluent discharge points. The mobile laboratory is designed to meet the specifications required by accepted methodology as identified in 'Methods for Acute Toxicity Tests with Fish, Macroinvertebrates and Amphibians,' EPA-660/3-75-009, April 1975. Effluent, pumped to the laboratory, is proportionally mixed with the receiving water and delivered to test containers. Toxicity tests are conducted on different effluent concentrations for a standard 96-hour period; each exposure and controls are tested in duplicate. The fathead minnow is used as the test organism, because it is indigenous to most of the U.S., is easy to maintain and reproduce in the laboratory, and is commercially available. Testing requirements, construction materials, and equipment are discussed. The testing procedure is described. The results of toxicity tests conducted on 11 different discharges from five industrial types show all but two produced some level of measurable acute toxicity. Schematic diagrams illustrate the laboratory floor plan and the laboratory interior. (Davison-IPA) W79-07974

BIONITORING OF PULP AND PAPER EFFLUENTS

Institute of Paper Chemistry, Appleton, WI.
E. F. Zanella, G. Katz, and G. Shoemaker.
In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978. p 137-142, 2 fig, 2 tab.

Descriptors: *Pollution abatement, *Water quality, *Bioindicators, *Aquatic invertebrates, *Municipal wastes, *Industrial wastes, *Pulp wastes, Water quality control, North Branch Potomac River(Maryland), Luke(Maryland), Westvaco Corporation, Biochemical oxygen demand, Suspended solids.

The biological water quality investigation of effluent from the Westvaco Corporation mill in Luke, Maryland, relies on the distribution and community structure parameters of resident macroinvertebrates of the North Branch Potomac River to indicate changes in water quality. Data were collected from 12 mainstream stations and three tributary stations over 18 years from 1959 to 1976. A regional waste treatment facility constructed by the Upper Potomac River Commission (UPRC) 1960 treats mill effluents and municipal wastes from three towns. Until recently the mill discharges included wastes treated by the UPRC facility and unsegregated process streams and discharges which went directly from the mill to the river. The main waste stream components of BOD5 and total suspended solids (TSS) for direct mill discharges, UPRC treatment plant discharges, and total discharges to the river are tabulated for the years of the monitoring program. Major reductions have occurred in the most recent five-year period, coinciding with the steady improvement in the macroinvertebrate community in the North Branch Potomac River. Immediately upstream from the mill site North Branch water quality is still in extremely poor condition. Water quality rapidly improves from the mill to mile 45, and for the last 20 miles of this study the biological communities indicate good to excellent water quality. Faunal distribution has increased 44% in the critical zone between mile -1.8 to mile 29 since the 1959 base line survey. (Davison-IPA) W79-07983

WATER QUALITY EFFORTS BY CHEMICAL INDUSTRIES

Virginia Polytechnic Inst. and State Univ., Blacksburg, Center for Environmental Studies.
A. C. Hendricks.
Interstate Commission on the Potomac River Basin, Rockville, MD. Technical Publication 78-2. In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978. p 143-146, 1 fig, 4 tab, 8 ref.

land, Flynn, K. C. and Mason, W. T., Eds., 1978. p 143-146, 1 fig, 4 tab, 8 ref.

Descriptors: *Pollution abatement, *Industrial wastes, *Chemical wastes, *Water quality control, Water pollution treatment, Pollutant identification, Water pollution sources, Potomac River basin, Avtex Fiber Plant(Front Royal VA).

The major chemical industries in the Potomac River basin have installed extensive treatment facilities to improve quality of their effluents. One plant, the Avtex Fiber Plant at Front Royal, Virginia, installed waste treatment facilities with primary and secondary treatments at the plant in 1974. The previous owner of the plant, FMC, initiated a bottom fauna and fish bioassay program in 1972 which is being continued by Avtex. The data from those programs indicates a reduction in effluent toxicity, particularly after the installation of the secondary treatment facility. Chemical parameters Avtex is required to monitor by the state of Virginia include: BOD5, zinc and total suspended solids. Over the past 10 years the water quality in the Potomac River basin has improved. It is concluded that the improvement appears to be due to the water quality enhancement efforts of the industries and municipalities of the basin. (Davison-IPA) W79-07984

THE DISTRIBUTION OF TRACE METALS IN THE WILDERNESS LAKES

National Physical Research Lab., Pretoria (South Africa). Applied Spectroscopy Div.
R. J. Watling.
Water S. A., Vol. 5, No. 1, p 1-13, January 1979. 9 fig, 5 tab, 17 ref.

Descriptors: *Water analysis, *Sediments, *Cores, *Sampling, *Metals, *Copper, Lead, Zinc, Iron, Manganese, Cobalt, Cadmium, Nickel, Mercury, Sodium, Potassium, Calcium, Strontium, Aluminum, Chromium, Water pollution sources, Trace metals, Wilderness Lakes(South Africa).

Surface water, sediment, and sediment core samples were taken in the Wilderness Lakes area on the coast between Cape Town and Port Elizabeth, South Africa, to provide information on the trace metals present in the lakes, and to establish trends in metal build-up. Concentrations of the following nine trace metals found in the surface waters are tabulated: Cu, Pb, Zn, Fe, Mn, Co, Ni, Cd, and Hg. Generally little overall variation for Cu, Pb, Zn, Ni, Co, and Cd was found. The relatively high levels of lead found near the northern and eastern ends of Swartvlei Lake near the town of Sedgfield are a possible result of urban pollution. Results for metal concentrations in the Wilderness Lakes sediments are tabulated for: Cu, Pb, Zn, Fe, Mn, Co, Ni, Cd, Na, K, Ca, Mg, Sr, Al, and Cr. Copper level in the sediments was low, but occasional isolated anomalies occur, such as that at the eastern end of Langvlei Lake which was attributed to pollution from adjacent road work. Lead and zinc distribution was elevated but uniform, and also associated with the road work in the upper reaches of the lagoon. Core sediment samples were analyzed statistically to obtain interelemental relationships. In addition to confirming the results obtained for the surface sediment samples, evidence of pollution from motor fuel was noted in the marked increase of lead in the top centimeters of some cores. Only cores from Sedgfield, Island Lake Yacht Club, and Island Lake Holiday Camp showed evidence of pollution by man. Correlation frequency diagrams indicate the area is relatively free of pollution with respect to metals. (Davison-IPA) W79-07994

5B. Sources Of Pollution

REPORT ON TOXIC/HAZARDOUS ORGANIC COMPOUNDS IN THE WABASH RIVER BASIN

Environmental Protection Agency, Chicago, IL. Central District Office.
D. H. Stoltenberg.

Group 5B—Sources Of Pollution

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Sources Of Pollution—Group 5B

UPTAKE OF METHYLAMINE (AN AMMONIUM ANALOGUE) BY MACROCYSTIS PYRIFERA (PHAEOPHYTA), California Inst. of Tech., Corona Del Mar. Kerckhoff Marine Lab. P. A. Wheeler. *Journal of Phycology*, Vol. 15, p 12-17, 1979. 3 fig, 5 tab, 18 ref.

Descriptors: *Absorption, *Ammonium compounds, *Phaeophyta, *Tissue analysis, *Methylamine, Nitrogen compounds, Plant physiology, Plant tissues, Radioactivity techniques, Tracers, Carbon radioisotopes, Inhibition, Chemical analysis, Marine algae, Water temperature, Hydrogen ion concentration, Enzymes, Nutrients.

The ammonium analogue, methylamine, is taken up rapidly from dilute solution by *Macrocystis pyrifera*. ¹⁴C-methylamine was used to characterize the transport system, with respect to dependence on external concentration, temperature, pH and substrate specificity. The results suggest that methylamine enters the algal tissue via a specific mediated transport system. Uptake of methylamine showed no consistent relation to the N content of the plant tissue, but was highly dependent on the portion of plant sampled and severely affected by cutting the tissue. The strong inhibition of methylamine uptake by ammonium and lesser inhibition by other alkylamines suggests that the uptake functions as an 'ammonium permease'. Uptake of ¹⁴C-methylamine can be used as a highly sensitive measure of NH₄⁺ uptake activity and should be a useful tool for studying NH₄⁺ uptake in the laboratory and field. (Deal-EIS) W79-07600

EXPANSION OF A CENTRAL CALIFORNIA KELP FOREST FOLLOWING THE MASS MORTALITY OF SEA URCHINS, California Univ., Santa Cruz. Center for Coastal Marine Studies. J. S. Pearse, and A. H. Hines. *Marine Biology*, Vol. 51, p 83-91, 1979. 6 fig, 1 tab, 27 ref.

Descriptors: *Mortality, *Phaeophyta, *Competition, *Kelps, *Sea urchins, *Diversity, Dominant organisms, Animal pathology, Plant groupings, Plant growth, Plant populations, Succession, Marine algae, Rhodophyta, Marine benthos.

The mass mortality by disease of a localized population of sea urchins, *Strongylocentrotus*, on the seaward side of a kelp forest was followed by the rapid seaward expansion of 4 species of brown algae, *Macrocystis pyrifera*, *Laminaria dentigera*, *Pterygophora californica*, and to a lesser extent, *Nereocystis leuckana*. One other brown alga, *Cystoseira osmundacea*, failed to become established in the newly available area. Competition among *M. pyrifera*, *L. dentigera*, *P. californica*, and *N. leuckana* apparently was severe, and within 1 year after the demise of the sea urchin, *M. pyrifera* formed a dense, nearly monospecific stand. Experimental removal of *M. pyrifera* demonstrated that the canopy of these plants limited light penetration to levels below that necessary for the growth and survival of other brown and red algae. (Deal-EIS) W79-07601

METAL CONTENTS OF THE TWO MARINE ALGAE FOUND ON IRON ORE TAILINGS, Chinese Univ. of Hong Kong. Dept. of Biology. M. H. Wong, K. Y. Chan, S. H. Kwan, and C. F. Mo. *Marine Pollution Bulletin*, Vol. 10, p 56-59, 1979. 2 fig, 2 tab, 20 ref.

Descriptors: *Marine algae, *Heavy metals, *Mine wastes, *Chaetomorpha, *Enteromorpha, *Tissue analysis, Iron, Manganese, Lead, Zinc, Nutrients, Adaptation, Chemical analysis, Calcium, Potassium, Magnesium, Sodium, Cytological studies.

The two marine algae, *Chaetomorpha brychagana* and *Enteromorpha crinita* are found abundantly on the iron ore tailings of Tolo Harbour, Hong Kong, with a rather high level of various metals. Tissue analysis of the algae revealed that the contents of

heavy metals (Fe, Mn, Pb and Zn) were higher than in the population collected from two uncontaminated sites faraway from the tailings. It was suggested that the algae were able to adapt to such a harsh environment with a comparatively high level of trace elements and the lack of basic nutrients. However, further studies are needed before any conclusion can be drawn. The delicate situation of the land-locked sea, Tolo Harbour, where the tailings and future heavy industrial site are situated, should not be overlooked. (Deal-EIS) W79-07609

RELATION BETWEEN TOXICITY AND ACCUMULATION OF VARIOUS CHLOROPHENOLS IN GOLDFISH,

Kyushu Univ., Fukuoka (Japan). Faculty of Agriculture. K. Kobayashi, H. Akitake, and K. Manabe. *Bulletin of the Japanese Society of Scientific Fisheries*, Vol. 45, No. 2, p 173-175, 1979. 3 fig, 1 tab, 7 ref.

Descriptors: *Phenols, *Toxicity, *Bioaccumulation, *Tissue analysis, *Chlorophenols, *Goldfish, *Carassius, Chlorine, Chlorination, Chemical properties, Lethal limit, Mortality, Fish physiology, Animal metabolism, Organic compounds, Chemical analysis.

A study was made of the relation between the toxicity and the accumulation in goldfish, *Carassius auratus*, of seven chlorophenols: 2-chlorophenol; 4-chlorophenol; 2, 4-dichlorophenol; 2, 4, 6-trichlorophenol; 2, 4, 6-trichlorophenol; 2, 3, 4, 6-tetrachlorophenol; and pentachlorophenol. An increase of the Cl-atom number in the chlorophenols caused an abrupt increase in toxicity to the fish and also increased the concentration ratios in their media to lethal or sublethal concentrations. The results suggest that the increase of toxicity from polychlorinated phenols is mostly due to their accumulation in the fish. Their concentrations in the fish eventually achieve a certain lethal level (roughly 100-200 micro/g body weight), although the chemical form, locality, and physiological activity of the chlorophenols in the tissues of the fish must also be involved. (Deal-EIS) W79-07614

TRENDS IN APPLIED PHYCOLOGY WITH A LITERATURE REVIEW: SEAWEED FARMING ON AN INDUSTRIAL SITE,

Department of Marine Botany, Goteborg (Sweden). G. Michanek. *Botanica Marina*, Vol. 21, p 469-475, 1978. 7 ref.

Descriptors: *Marine algae, *Kelps, *Phycology, *Seaweed, Marine plants, Foods, Phytoplankton, Biomass, Phaeophyta, Aquaculture, Plant physiology, Algae, Human diseases, Sewage.

Some aspects of trends in seaweed utilization are given as an introduction to a list of papers published during the last five years, pertinent to seaweed cultivation. Ocean farming projects of billion dollar magnitude are planned for energy recovery, to take over when natural gas sources are exhausted. Greenhouse cultivation methods are being elaborated to substitute for harvesting of natural resources and to give raw material of controlled chemical composition. Nutrient resources which have up to now been wasted through sewage can be taken advantage of, and their energy level raised, by plankton assimilation. In developing countries, harvesting on sea shores is replaced by culturing on ropes and rafts. The use of algae as human food is declining except for in Japan, China and Korea, and priceless know-how is rapidly being lost. It is observed that one trend is missing: the possibility of using seaweed as a remedy for diseases with wide distribution and prevalence such as goitre and intestinal worm infections. (Deal-EIS) W79-07619

CHANGES IN PHYTOPLANKTON PHYSIOLOGY AND MORPHOLOGY IN RESPONSE TO DISSOLVED NUTRIENTS IN LOUGH NEAGH, N. IRELAND,

Northern Ireland Dept. of Agriculture, Antrim. Freshwater Biological Investigation Unit. For primary bibliographic entry see Field 5A. W79-07621

TOXICITY AND BIOACCUMULATION OF HEXACHLOROCYCLOPENTADIENE AND HEXACHLORONORBORNADIENE AND HEPTACHLORONORBORNENE IN LARVAL AND EARLY JUVENILE FATHEAD MINNOWS, PIMEPHALES PROMELAS,

Environmental Research Lab., Duluth, MN. For primary bibliographic entry see Field 5C. W79-07622

BIOCONCENTRATION OF CHLORDANE BY THE GREEN ALGA SCENEDESMUS QUADRICAUDA,

Toronto Univ. (Ontario). Faculty of Forestry. For primary bibliographic entry see Field 5C. W79-07623

VESSEL-RELATED CONTAMINATION OF SOUTHERN CALIFORNIA HARBOURS BY COPPER AND OTHER METALS,

Southern California Coastal Water Research Project El Segundo. For primary bibliographic entry see Field 5C. W79-07628

CALANOID COPEPOD EGGS IN SEABOTTOM MUDS. IV. EFFECTS OF SOME ENVIRONMENTAL FACTORS ON THE HATCHING OF RESTING EGGS,

Hiroshima Univ. (Japan). Faculty of Fisheries and Animal Husbandry. S. Uye, S. Kasahara, and T. Onbe. *Marine Biology*, Vol. 51, p 151-156, 1979. 1 fig, 6 tab, 21 ref.

Descriptors: *Copepods, *Oxygen, *Salinity, *Water temperature, *Hatching, *Calanopia, *Labidocera, *Acartia, *Centropages, Bottom sediments, Reproduction, Oxygen requirements, Neritic, Japan, Benthic fauna, Plankton, Animal physiology, Seasonal.

The hatching of resting eggs of 6 species of marine calanoid copepods, recovered from neritic seabottom muds in the central part of the Inland Sea of Japan was examined under various environmental conditions (temperature, salinity, oxygen concentration, illumination and presence of bottom mud). Temperature and oxygen concentration were found to be important factors affecting hatching. The respective ranges of temperature in which the eggs of each species hatched correspond closely to the range of temperature at which the planktonic population of that species was observed in the natural environment. Extremely low oxygen concentrations in the water completely inhibited hatching in all species. A wide range of salinity and the presence of absence of illumination did not prevent hatching. (Deal-EIS) W79-07642

SOURCES OF HEAVY METAL CONTAMINATION IN A RIVER-LAKE SYSTEM,

Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst. For primary bibliographic entry see Field 5A. W79-07649

ADAPTATIONS TO SULFIDE IN THE MEIOFAUNA OF THE SULFIDE SYSTEM. I. 35S-SULFIDE ACCUMULATION AND THE PRESENCE OF A SULFIDE DETOXIFICATION SYSTEM,

North Carolina, Univ. at Chapel Hill. Dept. of Zoology. E. N. Powell, M. A. Crenshaw, and R. M. Rieger. *Journal of Experimental Marine Biology and Ecology*, Vol. 37, p 57-76, 1979. 4 fig, 2 tab, 58 ref.

Descriptors: *Sulfides, *Tracers, *Hydrogen sulfide, *Tissue analysis, *Bioaccumulation, *Turbellarians, *Gastrotrichs, *Proseriates, *Myopea, *So-

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

lenofilomorpha, *Pseudohaplogonaria, *Archiloea, Radioisotopes, Radiochemical analysis, Sulfur, Animal physiology, Animal metabolism, Adaptation, Resistance.

Life in the sulfide system requires the ability to withstand the toxic effects of long-term sulfide stress. The adaptations of sulfide-system interstitial metazoans to sulfide stress have been investigated using ³⁵S-sulfide. One possible adaptation, the total exclusion of sulfide at the body wall, could not be demonstrated. Sulfide-system turbellarians and gastropods, however, consistently incorporated less ³⁵S-sulfide during a 2-h incubation period than their surface-dwelling counterparts. Analysis of autoradiographs of the sulfide-system acoels *Myopea*, *Solenofilomorpha*, and *Pseudohaplogonaria* sp., and the surface-dwelling prosoplate *Archiloea* revealed major differences in the concentration of ³⁵S label in the body wall relative to the internal tissues. Timed uptake and loss experiments plus data from autoradiography showed that the label in the body wall was not permanently bound but, instead, was easily lost. The data indicate that a sulfide detoxification system exists in the body wall which uses an as yet unknown scavenging system to trap much of the sulfide that enters, detoxifies it, and releases the end-product to the medium. (Deal-EIS)

W79-07652

MERCURY ACCUMULATION IN IPOMOEA AQUATICA (FORSK) NEAR A CAUSTIC SODA FACTORY IN THAILAND,
Helsinki Univ. (Finland). Dept. of Environmental Science.

For primary bibliographic entry see Field 5C.
W79-07653

ALKANES IN PLANKTON FROM THE BUCKEYER OILFIELD,
Houston Univ., TX. Dept. of Biophysical Sciences.
For primary bibliographic entry see Field 5C.
W79-07655

MERCURY POLLUTION OF MEDITERRANEAN SEDIMENTS AROUND ALEXANDRIA, EGYPT,
Alexandria Univ. (Egypt). Faculty of Science.
For primary bibliographic entry see Field 5C.
W79-07656

DOMINANCE AND DISTRIBUTION OF BENTHIC MACROPHYTE ASSEMBLAGES IN A NORTH FLORIDA ESTUARY (APALACHEE BAY, FLORIDA),
Florida State Univ., Tallahassee. Dept. of Biological Science.
For primary bibliographic entry see Field 5C.
W79-07660

KEPONE: TOXICITY AND BIOACCUMULATION IN BLUE CRABS,
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5C.
W79-07679

THE DISTRIBUTION OF HEAVY METALS IN THE HARD CLAM, *MERCENARIA MERCENARIA*, IN THE LOWER CHESAPEAKE BAY REGION,
Bigelow Lab. for Ocean Sciences, Boothbay Harbor, ME.
P. F. Larsen.
Estuaries, Vol. 2, No. 1, p 1-8, 1979. 1 fig, 4 tab, 23 ref.

Descriptors: *Clams, *Heavy metals, *Tissue analysis, *Mercenaria, *James River (Virginia), *York River (Virginia), *Cadmium, *Copper, *Zinc, Chesapeake Bay, Commercial shellfish, Salinity, Water chemistry, Chemical analysis.

Populations of the hard clam, *Mercenaria mercenaria*, were sampled at thirty sites in the lower Chesapeake Bay region in 1972 and 1973. Subsamples were taken for analysis for the trace metals

cadmium, copper and zinc. Emphasis was placed on samples from the York and James Rivers, two very productive and commercially utilized clam grounds. The levels of metals determined were comparable to those reported from other regions except Southampton Water in the United Kingdom. Differences in levels between the York and James Rivers were statistically significant ($P < 0.001$) which indicates that the James River probably suffers from contamination by these metals. One metal, copper, varied significantly with the age of the organism whereas the other two, cadmium and zinc, varied with salinity. In *Mercenaria* the salinity of the sampling site must be considered before cadmium and zinc data can be interpreted. A standard action-level to denote pollution from copper would be adequate in this species. (Deal-EIS)

W79-07685

TRANSPORT, DISTRIBUTION AND TOXIC EFFECTS OF POLYCHLORINATED BIPHENYLS IN ECOSYSTEMS: REVIEW,
Tennessee Univ., Knoxville. Memorial Research Center and Hospital.

For primary bibliographic entry see Field 5C.
W79-07688

DISTRIBUTION AND FRACTIONATION OF ARSENIC IN SELECTED FRESH WATER LAKE SEDIMENTS,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.

For primary bibliographic entry see Field 5A.
W79-07689

CADMIUM SORPTION IN ESTUARINE MUD-TYPE SEDIMENT AND THE ACCUMULATION OF CADMIUM IN THE SOFT-SHELL CLAM, *MYA ARENARIA*,
District of Columbia Univ., Washington. Mount Vernon Square Campus.

For primary bibliographic entry see Field 5C.
W79-07691

OBSERVATIONS ON THE ENVIRONMENTAL CHARACTERISTICS OF PULICAT LAKE,
Central Inland Fisheries Research Inst. Madras (India).
M. Kaliyamurthy.
Journal of the Marine Biological Association of India, Vol. 16, No. 3, p 683-688, 1974. 4 fig, 18 ref.

Descriptors: *Monsoons, *Lakes, *Water analysis, *Seasonal, Water temperature, Salinity, Dissolved oxygen, Hydrogen ion concentration, Productivity, Fish populations, Tidal effects, Tidal waters, Neritic, Water circulation, India, Pulicat Lake.

Observations made during the years 1968 through 1970 on the spatial and temporal variations in temperature, salinity, dissolved oxygen and pH in Pulicat Lake are presented. Water temperature showed double oscillation in its seasonal changes, whereas salinity had a single peak during May/June. From the mouth to the upper reaches of the lake there was a decreasing salinity gradient during monsoon and postmonsoon, which became more or less reversed during premonsoon and summer. Higher values of dissolved oxygen were observed during monsoon and postmonsoon when compared to summer and premonsoon. Hydrogen ion concentration showed an inverse relationship with oxygen. Wider fluctuations in the environmental parameters were observed in the northern sector of the lake and the probable reasons for this are discussed. An attempt has been made to correlate the variations in salinity with the fish production of the lake. (Deal-EIS)

W79-07694

N15/N14 RATIOS OF GROUND-WATER NITRATE, LONG ISLAND, NEW YORK,
Texas Univ. at Austin. Bureau of Economic Geology.

C. W. Kreidler, S. E. Ragone, and B. G. Katz.
Ground Water, Vol. 16, No. 6, p 404-409, November-December 1978. 3 fig, 2 tab, 19 ref.

Descriptors: *Nitrogen, *Nitrates, *Isotope studies, *Groundwater, *Water pollution sources, Fertilizers, Animal wastes (Wildlife), *New York, *Long Island (NY), Nassau County (NY), Suffolk County (NY).

Nitrogen-isotope values of nitrate in water from the upper glacial aquifer are lighter in agricultural areas in eastern Long Island than in highly suburbanized areas in western Long Island. This reflects a shift in the dominant source of nitrate from fertilizer nitrogen and/or unfertilized cultivation nitrogen to a predominance of animal-waste nitrogen. Nitrogen-isotope values for nitrate in samples from the Magothy aquifer in Nassau and Suffolk Counties indicate that the nitrate is from a predominantly agricultural source with some animal wastes. Ground water in the Magothy aquifer is older than that in the upper glacial aquifer and should be representative of an older land-use pattern when agriculture was more widely practiced. Nitrogen-isotope values are lighter than those found in the overlying upper glacial aquifer in Nassau County, but heavier than those from the upper glacial aquifer in Suffolk County. (Woodard-USGS)

W79-07697

GROUND-WATER HYDROLOGY AND SUB-SURFACE MIGRATION OF RADIOISOTOPES AT A LOW-LEVEL SOLID RADIOACTIVE WASTE DISPOSAL SITE, WEST VALLEY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.

D. E. Prudic, and A. D. Randall.
In: Management of Low-Level Radioactive Waste, Vol. 2, p 853-882, Pergamon Press, New York, 1979. 14 fig, 2 tab, 10 ref.

Descriptors: *Hydrogeology, *Solid wastes, *Underground, Waste disposal, *Radioactive wastes, *Path of pollutants, Groundwater, Tritium, Nuclear wastes, Infiltration, Groundwater movement, Groundwater recharge, Aquifer characteristics, Sampling, Water analysis, Evaluation, *West Valley (NY).

Burial trenches for disposal of solid radioactive waste at West Valley, N.Y., are excavated in till that has very low hydraulic conductivity (about 5×10^{-10} to the minus 8th power centimeters per second). Fractures and root tubes with chemically oxidized and/or reduced soil in their walls extend 3 to 4.5 meters below natural land surface. Preliminary simulations of pressure heads with a digital model suggest that hydraulic conductivity is an order of magnitude greater in the fractured till near land surface than at greater depth. Hydraulic gradients are predominantly downward, even beneath small valleys. The upper part of a body of underlying lacustrine silt is unsaturated; in the lower, saturated part, slow lateral flow may occur. In the older trenches, water began to build up in 1971, overflowed briefly in 1975, and was pumped out in 1975-76. Water levels rose abruptly during major rainstorms in mid-1975, indicating rapid infiltration through cracks in the cover material. The new trenches have maintained low, stable water levels, perhaps because of thicker, more compact cover and less waste settlement; pressure heads near these trenches are low, locally approaching zero, perhaps because of slight infiltration and limited near-surface storage. Peak tritium concentrations in test-hole cores (generally 0.00001 to 0.001 microcuries per milliliter) were found within 3 meters of land surface and are attributed to surface contamination. Concentrations declined rapidly with depth within the fractured till; secondary peaks found at about 9 meters in three holes are attributed to lateral migration from trenches. Other radioisotopes were detected only near land surface. Samples from the walls of shallow fractures revealed no accumulation of radioisotopes. (Woodard-USGS)

W79-07713

DETERMINATION OF HYDROLOGIC PARAMETERS FOR GLACIAL TILLS IN CONNECTICUT,
Connecticut Univ., Storrs. Inst. of Water Re-

sources.
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TRACE AND MARSH AND SALE
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Descriptors:
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*Industrial
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Sources Of Pollution—Group 5B

sources.
For primary bibliographic entry see Field 2F.
W79-07715

TRACE AND TOXIC METAL UPTAKE BY MARSH PLANTS AS AFFECTED BY EH, PH, AND SALINITY.
Louisiana State Univ., Baton Rouge. Center for Wetlands Resources.
For primary bibliographic entry see Field 2K.
W79-07727

THE EFFECT OF LAKE DESTRATIFICATION ON WATER QUALITY.
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2H.
W79-07745

NUTRIENT BUDGET ANALYSIS FOR REND LAKE IN ILLINOIS.
Illinois State Water Survey, Peoria. Water Quality, Section.
For primary bibliographic entry see Field 5A.
W79-07748

HYDROCHEMICAL EVIDENCE OF SEA WATER INTRUSION ALONG THE MANGROVE COAST OF SAURASHTRA, GUJARAT.
Physical Research Lab., Ahmedabad (India).
For primary bibliographic entry see Field 2L.
W79-07752

MANAGEMENT OF SMALL WASTE FLOWS.
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5D.
W79-07774

THE SOURCES AND BEHAVIOR OF HEAVY METALS IN WASTEWATER AND SLUDGES.
Battelle Columbus Lab., OH.
B. W. Vigon, R. A. Craig, and N. A. Frazier.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-265 006.
Price codes: A04 in paper copy, A01 in microfiche.
Report EPA-600/2-77-070, 1977. 63 p, 26 tab, 41 ref.

Descriptors: *Heavy metals, *Sewage sludge, *Treatment facilities, *Water pollution sources, *Industrial wastes, Urban runoff, Agriculture, Peak loads, Waste water treatment, Municipal wastes.

A review of the literature available on the point and non-point sources and behavior of heavy metals in municipal waste water treatment plants and in sewage sludges was prepared. Inconsistent results were found in previous studies of heavy metals in municipal waste water. The heavy metal concentrations from residential sources varied significantly with the element studied and the geographic location. The residential contribution of heavy metals was rarely more than 50% of the total load. Inconsistencies among previous studies were attributed to the inclusion of unsurveyed industrial discharges. The correlation of heavy metal content in sludge with industrial density was considered inappropriate since diffuse sources of heavy metals such as laundries, street runoff, and family-owned operations can contribute to concentrations from a supposedly residential section. Because peak flows are usually bypassed, the contribution of urban runoff to metal levels at treatment plants was not considered significant compared to other sources. Individual studies of point-source heavy metals were considered necessary in areas where municipal sewage sludge containing heavy metal concentrations exceeding acceptable limits is used for agricultural purposes. (Lisk-FRC)
W79-07782

RESULTS OF INVESTIGATIONS, T. E. MAXSON WTP AND SIGNIFICANT INDUSTRIAL CONTRIBUTORS, MEMPHIS, TENNESSEE.

Report EPA-904/9-77-005, 1977. 236 p, 10 fig, 65 tab, 13 ref, 5 append.

Descriptors: *Treatment facilities, *Design flow, *Design data, *Pollutant identification, *Discharge measurement, Industrial wastes, Organic loading, Bioassay, Activated sludge, Oxidation lagoons, Waste water treatment, Municipal wastes.

Operation and maintenance investigations, bioassay toxicity studies of plant influent and effluent, and waste characterization studies of significant industrial waste water contributors were performed at the T. E. Maxson waste water treatment plant in Memphis, TN, to determine the capability of the plant to treat present and projected waste loads, to characterize the significant waste sources discharging into the collection system, and to verify previous performance data. The 80 mgd contact stabilization activated sludge plant was designed to reduce BOD by 85% and suspended solids by 90% but study data indicated that the plant achieved removals of 69% BOD, 54% COD, and 45% total suspended solids. The average waste water flow was 49% of the design capacity while the organic loading as BOD was 104% of the design load and as high as 140% on one study day. The plant influent had significant amounts of chlordane, chloroform, ramrod, and terpineol isomer; significant amounts of these substances were also found in the plant effluent. Influent and effluent were toxic to waterfleas and bluegill sunfish; while the toxic compounds could not be identified, chlordane and atrazine found in the waste water had been found toxic in other bioassays. The contact stabilization process and digesters did not receive enough air for proper operation; the plant received shock loadings; restricted hydraulic conditions prevented the plant from operating at design flow; and mechanical problems were identified. Some of the 162 industrial waste water discharges were investigated. (Lisk-FRC)
W79-07788

FINAL REPORT ON FATE OF METALS APPLIED IN SEWAGE AT LAND WASTEWATER DISPOSAL SITES.
Texas A and M Research Foundation, College Station.

K. W. Brown, C. Woods, and J. F. Slowey.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A043 363.
Price codes: A15 in paper copy, A01 in microfiche.
Report, 1975. 344 p, 52 fig, 27 tab, 59 ref, 9 append.

Descriptors: *Heavy metals, *Soil types, *Soil profiles, *Leachate, *Lysimeters, Waste water disposal, Copper, Zinc, Cadmium, Nickel, Lead, Bermuda grass, Sampling, Root zone, Waste water treatment, Municipal wastes, Sewage.

The fate of copper, zinc, cadmium, nickel, and lead contaminants in secondary sewage effluent applied to four different soils at waste water disposal sites was investigated. Five undisturbed monoliths of each soil type were enclosed in drainage lysimeters, and field plots of two of the soils were similarly established. The effluent samples, bearing 1 ppm of each of the metal contaminants, were applied at an average rate of 2.7 cm/wk for one year. Rainfall was excluded from the plots. Heavy metal concentrations were analyzed in samples of Bermuda grass, soil samples at a series of depths, and samples of water in the root zone from the bottom of the lysimeters. The total metal content, and the soluble, exchangeable, and organic bond fractions in the soil samples were also investigated. The effects of pH adjustment of the sewage effluent, rainfall, and the application of primary clarified effluent on the fate of the metals were examined. Other hydrologic and meteorological data were also monitored. Metals accumulated primarily in the top 12.5 cm of soil with the greatest concentrations found at the surface. The movement of metals downward through the soils were slow; no metals appeared in leachate collected at 75 cm and 150 cm in any of the soils. Vegetation uptake of the metals was minimal during the study. (Lisk-FRC)
W79-07789

THE SURVIVAL OF HUMAN ENTERIC VIRUSES IN HOLDING PONDS.
Texas Univ. at San Antonio. Center for Applied Research and Technology.
For primary bibliographic entry see Field 5D.
W79-07790

WASHINGTON STATE REFINERIES: PETROLEUM, PETROLEUM DERIVATIVES AND WASTEWATER EFFLUENT CHARACTERISTICS.
Oceanographic Inst. of Washington, Seattle.
J. T. Pizzo, T. L. Johnson, and G. W. Harshman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-283 401.
Price codes: A06 in paper copy, A01 in microfiche.
Report EPA-600/7-78-040, 1978. 169 p, 21 fig, 70 tab, 121 ref, 3 append (on fiche).

Descriptors: *Oil industry, *Oil wastes, *Effluent streams, *Performance, *Waste water treatment, Phenols, Sulfides, Chromium, Water pollution sources, Waste water treatment, Industrial wastes.

Refinery waste water effluent characteristics in Washington State were studied to detail the types of petroleum and petroleum derivatives that potentially could reach the Puget Sound. Information was collected on the chemical characteristics, amounts processed, and final disposition of crude oils, refined products, and waste water effluents associated with the six Puget Sound refineries. The amounts and types of petroleum and its derivatives handled by Puget Sound refineries and the amounts typically reaching marine waters are described. The refining and waste treatment processes employed by area refineries are described in detail. The final treated effluent contains a wide variety of chemical constituents and characteristics as it is virtually impossible to completely eliminate the pollutants which arise from crude oil refining. Average effluent level of phenols was 0.4 ppm, total oils was 5-10 ppm, sulfides was 0 ppm, mercaptans was 0 ppm, and total chromium was 0.1. (Small-FRC)
W79-07799

EVALUATION OF LEACHATE TREATMENT VOLUME 1: CHARACTERIZATION OF LEACHATE.
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W79-07807

DISCHARGE OF HEAVY METALS TO MUNICIPAL SEWERS 'THE CRUNCH MAY COME'.
Ontario Ministry of the Environment, Toronto. Wastewater Treatment Section.
For primary bibliographic entry see Field 5D.
W79-07850

CONTROLLING PCB DISCHARGES TO THE ENVIRONMENT.
New York State Dept. of Environmental Conservation, Albany. Div. of Pure Waters.
N. A. Curry.
In: Proceedings of the 23rd Ontario Industrial Waste Conference, June 13-16, 1976, Toronto, Ontario, p 449-473. (1976) 2 fig, 4 tab, 7 ref, 1 append.

Descriptors: *Polychlorinated biphenyls, *Waste disposal, *Landfills, *Regulation, Leachate, Pesticide residues, Water pollution sources.

The control of PCB discharges to the environment and control over the disposal of discarded units containing PCBs are discussed. Manufacturing plants have discharged PCBs dissolved in the water, adsorbed onto suspended solids, dispersed in droplets, or dissolved in any oil or grease in the water effluent. At the Hudson Falls Plant of General Electric, about 38 ppb PCB was found in the inlet water. After suspended matter was removed, there was less than 1 ppb PCB. Discharges of PCBs tend to cycle from air to water to soil. Past landfills contain an estimated 300,000,000 pounds of PCBs and 750,000,000 pounds are in sealed units

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

in use. Regulation of disposal of discarded units is required, and new chemical landfills must be provided to contain leachate for complete destruction. Use must be limited and regulated to prevent discharge and rupture. Adequate substitutes for PCBs must be developed. (See also W79-07849) (Small-FRC)
W79-07857

MANUAL FOR THE CONTROL OF HAZARDOUS MATERIAL SPILLS. VOLUME ONE. SPILL ASSESSMENT AND WATER TREATMENT TECHNIQUES.

Envirex, Inc., Milwaukee, WI. Environmental Sciences Div.
K. R. Huijbregtse, R. C. Scholz, R. E. Wulfschlegel, J. H. Moser, and E. R. Bollinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-276 734. Price codes: A21 in paper copy, A01 in microfiche. Report EPA-600/2-77-227, 1977. 471 p, 94 fig, 43 tab, 83 ref.

Descriptors: *Hazards, *Accidents, *Assessments, Public health, Safety.

A manual for the control of hazardous waste spills using improvised treatment systems is presented. The following topics are covered: notification, information sources, identification and assessment, determination of the best method for spill handling, safety consideration and process design, process construction and operation, and process components and treatment chemicals, and standard operating procedures during cleanup. The manual emphasizes spill control although prevention techniques are reviewed. The CHRIS-Vol. 3 Hazard Assessment is recommended for establishing human danger potential. Necessary treatment schemes are included for 303 hazardous wastes. Necessary safety procedures and process designs are presented. (Small-FRC)
W79-07868

DIFFUSE SOURCE POLLUTION: POLICY CONSIDERATIONS FOR THE STATES.
Council of State Governments, Washington, DC.
For primary bibliographic entry see Field 6E.
W79-07879

A REVISION OF EXISTING REGULATIONS OF THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM.
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 6E.
W79-07883

CONSERVATION DISTRICTS AND 208 WATER QUALITY MANAGEMENT-NON-POINT SOURCE IDENTIFICATION AND ASSESSMENT, SELECTION OF BEST MANAGEMENT PRACTICES, MANAGEMENT AGENCIES, REGULATORY PROGRAMS.
National Association of Conservation Districts, Washington, DC.
For primary bibliographic entry see Field 4A.
W79-07886

COAL MINE WATER POLLUTION - LEGAL AND REGULATORY ISSUES: A SURVEY.
A. B. Fisher.
Illinois Institute of Natural Resources, Chicago, Illinois, Document No. 78/33, October, 1978, 43 p.

Descriptors: *Coal mine wastes, *Water quality standards, *Water pollution control, Economic impact, Chlorides, Sulfates, Dissolved solids, Effluents, Water pollution, Regulation, Legislation.

Legal and regulatory issues are surveyed regarding coal mine water pollution in 6 states: Colorado; Indiana; Kentucky; Ohio; Pennsylvania; West Virginia; and Wyoming. No state has sought to impose expensive treatment technology upon coal mine operators, but they have resorted to the following strategies: (1) mine discharges being diverted to an alternate watershed (Ohio); (2) violations

of water quality standards being ignored (Pennsylvania); (3) water quality standards which would place a burden on coal mine operators not being promulgated in the first place or being easily removed if compliance is economically or technically infeasible (West Virginia); (4) streams which only exist when it rains but which may receive discharges from coal mining operation being excluded from water quality standards (Kentucky); (5) streams or stream segments which have been severely polluted by coal mine drainage through time being exempt from water quality standards (Ohio). Four appendices contain the following information: (1) a comparison of typical coal values for each state; (2) a comparison of the number of bituminous coal mines for each state; (3) the demonstrated coal reserves for each state; and (4) the agency in each state designated to coordinate the 1977 Surface Mining Control and Reclamation Act. (Vloedman-Florida)
W79-07887

NATIONAL WATER QUALITY GOALS CANNOT BE ATTAINED WITHOUT MORE ATTENTION TO POLLUTION FROM DIFFUSED OR 'NONPOINT' SOURCES.
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 2E.
W79-07889

EXPANDED OFFSHORE LEASING AND THE MANDATES OF NEPA.
J. E. McDermott.
Natural Resources Lawyer, Vol. 10, No. 3, p 531-53, 1977.

Descriptors: *Continental shelf, *Oil, *Leases, *Administrative agencies, Environmental effects, Environment, Oil pollution, Offshore platforms, Administrative decisions, Water pollution, Judicial decisions.

To reduce America's growing dependence on foreign oil, the United States Department of the Interior has been progressing rapidly with its plans for accelerated nationwide oil and gas leasing on the Outer Continental Shelf (OCS). The legality of the Interior's decision to implement accelerated OCS leasing both nationwide and in Southern California is explored. In connection with its decision, the Interior undertook environmental review procedures of questionable legality and propriety: (1) it failed to recirculate for further public comment a draft of a substantially amended programmatic Environmental Impact Statement (EIS); and (2) it undertook significant tract activities, including a tract specific environmental review process in Southern California, before the release of a final programmatic EIS and before the decision to implement the national leasing program. As a result, the integrity of the Interior's decisionmaking process was potentially compromised. More importantly, if the same procedures are adopted by other agencies in similar environmental review contexts, the future viability of the National Environmental Policy Act's environmental review process could be jeopardized. (Fortin-Florida)
W79-07898

ACID COAL MINE DRAINAGE: PAST POLLUTION AND CURRENT REGULATION.
West Virginia Univ., Morgantown. Coll. of Law.
For primary bibliographic entry see Field 6E.
W79-07905

RECENT CONGRESSIONAL ACTION ON OUTER CONTINENTAL SHELF OIL AND GAS DEVELOPMENT.
For primary bibliographic entry see Field 6E.
W79-07906

AN INTENSIVE STUDY OF THE HEAVY HYDROCARBONS IN THE SUSPENDED PARTICULATE MATTER OF SEAWATER.
Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
P. L. Parker, and S. Macko.
In: 'Environmental Studies, South Texas Outer

Continental Shelf, Biology and Chemistry,' Texas University Marine Science Institute, Supplemental Reports to Contract AA550-CT6-17, to the Bureau of Land Management, p 11-1 - 11-30, 1979. 13 fig, 10 tab. AA550-CT6-17.

Descriptors: *Texas, *Aromatic compounds, *Water pollution sources, Environmental effects, Water pollution effects, Baseline studies, Resources development, *Outer Continental Shelf, *Hydrocarbons, Petrogenic hydrocarbons, Suspended particulates, South Texas Outer Continental Shelf(STOCS).

Samples of particulate matter taken at three stations along Transect II were analyzed by GC and GC/MS/Data System. Total particulate hydrocarbon concentrations were found to decrease with distance offshore. The concentration of higher molecular weight hydrocarbons(C28 - C30) however, remained relatively constant. Such a distribution could be explained by production/introduction of hydrocarbons inshore with subsequent movement offshore. Preferential retention to higher molecular weight hydrocarbons during weathering could account for their more uniform concentration. Polycyclic aromatic compounds were found in benzene eluates of each sample. Among the compounds identified were: alkyl naphthalenes, phenanthrenes and dibenzothiophenes. Fluoranthene and pyrene were also found. A petroleum origin for the aromatics is likely. (Sinha-OEIS)
W79-07922

CHATTAHOOCHEE RIVER THERMAL ALTERATIONS.
Geological Survey, NSTL Station, MS. Water Resources Div. and Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 6A.
W79-07936

MODELING HIGHLY TRANSIENT FLOW, MASS, AND HEAT TRANSPORT IN THE CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA.
Geological Survey, NSTL Station, MS. Water Resources Div.
H. E. Jobson, and T. N. Keefer.
Geological Survey open-file report 79-270, January 1979. 139 p, 43 fig, 4 tab, 30 ref.

Descriptors: *Open channel flow, *Model studies, *Mathematical models, *Streamflow, *Heat transfer, Thermal pollution, Hydroelectric plants, Reservoir releases, Path of pollutants, Dye releases, Tracking techniques, Tracers, Water temperature, Hydrologic data, Equations, Evaluation, Georgia, *Chattahoochee River, *Buford Dam, *Norcross(Ga), Transport modeling.

A coupled flow-temperature model has been developed and verified for a 27.9-km reach of the Chattahoochee River between Buford Dam and Norcross, Ga. Flow in this reach of the Chattahoochee is continuous but highly regulated by Buford Dam, a flood-control and hydroelectric facility located near Buford, Ga. Calibration and verification utilized two sets of data collected under highly unsteady discharge conditions. Existing solution techniques, with certain minor improvements, were applied to verify the existing technology of flow and transport modeling. A linear, implicit finite-difference flow model was coupled with implicit, finite-difference transport and temperature models. Both the conservative and nonconservative forms of the transport equation were solved, and the difference in the predicted concentrations of dye were found to be insignificant. The temperature model, therefore, was based on the simpler non-conservative form of the transport equation. (Woodward-USGS)
W79-07943

LAND USE INFLUENCES ON METALS IN STORM DRAINAGE.
Geological Survey, Columbus, OH. Water Resources Div., and Occoquan Monitoring Lab., Manassas, VA; and Virginia Polytechnic Inst. and State Univ., Blacksburg.

D. R. Helsel, Randall, and Journal of the Vol. 51, No. 13 ref.

Descriptors: *Metals, *Water quality standards, *Farms, Forest analysis, Zinc, Iron, Manganese, *Four M

Swale wash discharges in fact factor in Occoquan Reservoir for the water along with the Washington, lands ranging in the Occoquan high-density km. The pur and compare from small bas materials are n tals. Yet a node, with t metal, the on environment. chromium, co (Woodard-USGS)
W79-07954

DEVELOPMENT OF A POLLUTION MONITORING SYSTEM FOR THE CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA.
Department of Hydrology, E. E. Jackson, Jr. Hydrology Reports 32-42, 1979. 142 p, 10 fig, 10 tab, 10 ref.

Descriptors: *Groundwater, *Sampling, *Seismicity, *Percutaneous Laboratory

Progress is reviewed and solved and s water flow sy at the Chalk Field measure analysis were c parameters for these pro discussed. Th to obtain un aquifer mater sampler and t from the sam coefficients fo water and se ally. Flow analyses and d tial water a W79-07957

TOXIC SUBSTANCES IN VIRGINIA.
Virginia State R. W. Ayers. Interstate C Basin, Rockv in: The Fre ties and Envi Symposium, and, Flynn, 10-96, 7 fig, 1

Descriptors: *Pesticides, *Aquatic po

Sources Of Pollution—Group 5B

D. R. Helsel, J. I. Kim, T. J. Grizzard, C. W. Randall, and R. C. Hoehn.
Journal of the Water Pollution Control Federal, Vol. 51, No. 4, p 709-717, April 1979. 7 fig, 8 tab, 13 ref.

Descriptors: *Water pollution sources, *Heavy metals, *Land use, *Surface waters, *Watersheds (Basins), Runoff, Path of pollutants, Farms, Forests, Urban runoff, Storm runoff, Water analysis, Zinc, Lead, Chromium, Copper, Cadmium, Iron, Manganese, Virginia, *Occoquan watershed, *Four Mile Run watershed.

Swale washoff in rural areas and storm sewer discharges in developed subbasins, are an important factor in the declining water quality of the Occoquan Reservoir in Virginia. Data are presented for the watershed tributary to this reservoir, along with the Four Mile Run watershed near the Washington, D.C., city line. The two basins drain lands ranging from farms and undisturbed forests in the Occoquan headwaters to commercial and high-density residential areas along Four Mile Run. The purpose of the study was to characterize and compare the surface runoff of seven metals from small basins of differing land use types. Many metals are required by organisms as micronutrients. Yet at higher concentrations they can be toxic, with the toxicity level depending on the metal, the organism exposed, and the chemical environment. The metals analysed are zinc, lead, chromium, copper, cadmium, iron and manganese. (Woodward-USGS)

W79-07954

DEVELOPMENT OF METHODS FOR SAMPLING, PRESERVING AND ANALYZING CONTAMINATED GROUND WATERS AND AQUIFER SEDIMENTS.

Department of the Environment, Ottawa (Ontario). Hydrology Research Div.

R. E. Jackson.

In: Hydrology Research Division, Annual Progress Reports and Short Research Notes, 1977-78. p 12-42, 1979. 7 fig, 8 ref. Environment Canada Inland Waters Directorate, Ottawa, Report Series No. 64. HR 75-1.

Descriptors: *Path of pollutants, *Hydrogeology, *Groundwater, *Water pollution, Analytical techniques, Measurements, Aquifer characteristics, Sampling, Sediments, Connate water, Strontium, Cesium, Perch Lake (Canada), Chalk River Nuclear Laboratories.

Progress is reported on the measurement of dissolved and sorbed contaminants in the groundwater flow system of the Lower Perch Lake Basin at the Chalk River Nuclear Laboratories (CRNL). Field measurement and sampling, preservation, and analysis were used to measure the hydrogeochemical parameters of the lake basin. The procedures for these processes and the equipment used are discussed. The method being developed at CRNL to obtain undisturbed samples of contaminated aquifer materials involves the use of a sediment sampler and the separation of the interstitial water from the samples. To determine the distribution coefficients for strontium 90 and cesium 137 the water and sediment samples are counted individually. Flow charts illustrate hydrogeochemical analyses and the procedures for sediment and interstitial water analysis. (Davison-IPA)

W79-07957

TOXIC SUBSTANCES IN OPEQUON CREEK, VIRGINIA.

Virginia State Water Control Board, Richmond. R. W. Ayers.

Interstate Commission on the Potomac River Basin, Rockville, Md. Technical Publication 78-2. In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978. p 90-96, 7 fig, 1 tab, 8 ref.

Descriptors: *Pesticide residues, *Pesticide kinetics, *Pesticide toxicity, *Persistence, *Food chains, *Aquatic populations, *Fish, Path of pollutants,

Ecosystems, Monitoring, Pesticides, Organic pesticides, DDT, Dieldrin, Endrin, Polychlorinated biphenyls, Water analysis, Water pollution sources, Water quality, Opequon Creek (Virginia).

A 13-month monitoring program was conducted during 1973 and 1974 on the Opequon Creek, Virginia, to examine the extent of biological accumulation of toxic pesticide residues in an aquatic ecosystem. Samples of water, fish, and sediments were analyzed for all pesticide compounds to locate phases of the environment in which pesticide residues were concentrated, to determine variations in seasonal pesticide occurrences, and to evaluate the importance of the food chain in biological accumulation of pesticide residues. Data on pesticide residues in fish tissues and bottom sediments were updated during an August 1976 survey. Pesticides and their uptake by fish are emphasized in a discussion of the theoretical concepts of biological accumulation of toxic substances. Of the 195 water samples analyzed, 38% were contaminated with one or more pesticides. A total of 13 pesticide compounds were found, most of which were organochlorines; organophosphates and herbicides were also present. Pesticide residues in the water correlated with pesticide application activity. The lower food chain level exhibited the highest contamination level; the upper food chain level had the lowest total residue levels of all fish collected, supporting the theory of direct environmental uptake of pesticides. Fish collected at the end of the heavy pesticide application period in August had higher residues than those collected in February, the slack period for pesticide application activity. The results indicate that persistent organochlorine pesticide residues may be diminishing because fewer of these chemicals are used in agriculture. (Davison-IPA)

W79-07975

STORM RUNOFF AND COMBINED SEWERS IN WASHINGTON, D. C.

American Univ., Washington, DC. Dept. of Biology.

M. A. Champs.

In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. D. and Mason, W. T., Eds., 1978. p 151-154, 7 fig, 12 ref. Interstate Commission on the Potomac River Basin, Rockville, MD. Technical Publication 78-2.

Descriptors: *Combined sewers, *Discharge measurement, *Overflow, *Rainfall-runoff relationships, *Organic loading, *Carbon, *Discharge (Water), *Sewerage, Nutrients, Water pollution, Water pollution sources, Storm runoff, Average runoff, Potomac River, Washington (DC).

Storm loadings of dissolved and particulate organic carbon are summarized for the Washington, D. C. area. Dry flow, street runoff, and combined sewer overflow from residential and industrial areas are compared to the Potomac River yearly averages and storm crests. A National Pollutant Discharge Elimination System Discharge Permit (NPDES) was issued to the District of Columbia for discharges to the Potomac River and its tributaries for 72.2% of the city's total combined sewer acreage. Researchers found that a 'significant portion' of the total storm-water pollutional loads to the streams of the District of Columbia come from combined sewer discharges. Sanitary sewage contributes about half of the organic and more than 50% of the nutrient loadings in combined sewer discharges. The average organic and nutrient concentrations of rainfall runoff are about 1/3 of those in combined sewer discharges in the Washington, D. C. area. Factors affecting the loading intensity in storm and combined sewers and their overflows include: surrounding land use, the time elapsed since streets were cleaned, the degree of cleaning, local traffic volume and type, street surface type and condition, construction practices, public works practices, and season of the year. Dissolved and particulate organic carbon concentrations in street runoff, storm and combined sewers, and overflows were found to be four to 10 times higher than water samples from the Potomac River. (Davison-IPA)

W79-07986

URBAN RUNOFF AND THE STREAM LIFE OF THE OCCOQUAN.

Occoquan Water Shed Monitoring Lab., Manassas, VA.

J. T. Kim, T. J. Grizzard, C. W. Randall, and R. C. Hoehn.

In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. D. and Mason, W. T., Eds., 1978. p 155-160, 6 fig, 1 tab, 12 ref. Interstate Commission on the Potomac River Basin, Rockville, Md. Technical Publication 78-2.

Descriptors: *Urban runoff, *Water pollution sources, *Water pollution effects, *Water management, Nutrients, Phosphorus, Nitrogen, Heavy metals, Iron, Lead, Zinc, Rainfall, Runoff, Occoquan Reservoir (Virginia).

The Occoquan Reservoir, on a major tributary of the Potomac estuary, was impounded in 1957 to provide a raw water supply to the Virginia suburbs of Washington, D. C. Although waste water discharges continue to contribute a significant amount of the pollutional load on the impoundment, recent studies show that contribution from runoff sources is clearly important. Data were collected from three sub-basins (Stonewall Road, Irongate, and Manassas Mall) during a compound storm event in August 1976. No runoff occurred for nine days before the event. The precipitation total for each site was the same, but the total runoff volumes varied widely because of differences in impervious area and sub-basin size. The nitrogen (N) and phosphorus (P) content in the runoff exceeded the accepted limits by factors of 25 for N and 100 for P at times. The initial high peak value appeared at the onset of runoff. Iron concentrations, highest at Irongate and Stonewall Road, were about 90% attached to suspended material. High concentrations of zinc and lead were observed for Irongate and Manassas Mall because of automobile operation at these sites. Although the high concentrations of zinc were within the acceptable ranges for public water supplies, those for lead exceeded the 0.05 mg/l limit. It is concluded that urban areas seem to have the capacity to export water pollutants from storm drainage at sufficient levels so that concern for the aquatic habitat becomes important. (Davison-IPA)

W79-07987

NUTRIENT MODELING.

Hydroscience, Inc., Arlington, TX.

P. J. Young.

In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. D. and Mason, W. T., Eds., 1978. p 161-166, 5 fig, 3 tab, 2 ref. Interstate Commission on the Potomac River Basin, Rockville, MD. Technical Publication 78-2.

Descriptors: *Mathematical models, *Nutrients, *Nutrient removal, *Evaluation, Regression analysis, River basins, River flow, Fluctuations, Nitrogen, Phosphorus, Potomac River, Water pollution, Water pollution sources, Pollution abatement, Luke (Maryland), Little Falls (Maryland), Potomac River basin.

A review of a recent study is presented in which the nutrient levels of the freshwater Potomac were determined, and the effectiveness of controls to lower these nutrient levels was evaluated. The investigation of the relationships between nutrient concentrations and flow included analyses of seasonal effects, sequences within individual runoff events, and regression analyses of concentration and loading rate versus flow. To characterize and determine the controllability of the nutrients reaching the estuary a mathematical model of the upper Potomac River was developed. The model, consisting of 47 segments from Luke to Little Falls, Maryland, is able to handle point and distributed loadings for conservative or non-conservative substances. Three basic steps were followed for each of the three distinct flow periods modeled. Step 1

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Group 5B—Sources Of Pollution

involved setting up a calculation to include the estimated loadings to the main step from all sources contributing nutrients during the flow period. Step 2 was concerned with estimating the natural background effects and assumed no input from man's activities. The added effects of point sources are taken into account by Step 3. It was demonstrated that nitrogen and phosphorus seemed to behave non-conservatively during summer low flow periods. On an annual basis nitrogen was considered to behave conservatively throughout the basin, but phosphorus continued to demonstrate non-conservative characteristics. The effectiveness of controls to remove nutrients was computed with logarithmic regressions and the modeling analysis. The 11 specific conclusions resulting from this study are presented. (Davison-IPA)

W79-07988

5C. Effects Of Pollution

MONITORING SPAWNING GRAVEL IN MANAGED FORESTED WATERSHEDS, A PROPOSED PROCEDURE.
Corvallis Environmental Research Lab., OR. Ecosystems Modeling and Analysis Branch.
M. A. Shirazi, D. H. Lewis, and W. K. Seim.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 273. Price codes: A02 in paper copy, A01 in microfiche. Report No. EPA-600/3-79-014, February 1979. 19 p, 2 fig, 3 tab, 8 ref.

Descriptors: *Aquatic habitats, *Spawning, *Water pollution, *Water pollution sources, *Sediments, Fish management, Fish conservation, Ecology, Environmental effects, Salmonids, Streambeds, Sampling, Gravels, Coarse aggregates, Gravimetric analysis, Water analysis, Forest management, Watershed management, Monitoring.

Because silvicultural activities in the Pacific Northwest introduce various levels of sediments and debris into streams degrading the spawning habitats of salmonid fishes, simple, reliable procedures are needed to monitor spawning substrate to assess the possible level of these impacts. A preliminary rationale for conducting such a monitoring program is presented for both individual spawning sites as well as for the entire stream. Spawning takes place in these mountain streams in riffles six to 36 inches deep with a water velocity of 1.5 to 2.5 ft/sec. The proposed monitoring procedure consists of the following steps: (1) select known spawning areas in stretches of a stream being impacted; (2) identify patches of spawning gravel and measure these areas; (3) estimate the range of gravel composition of each spawning riffle by sampling; (4) use a grab sampler under low water conditions after emergence; (5) three gallons or more of gravel to be collected, if gravel is coarse; (6) the gravel is to be wet-sieved on-site and the coarse fraction is to be analyzed volumetrically; (7) collect remaining gravel in 63 micron sieve, dry sieve in the laboratory and analyze gravimetrically; (8) estimate gravel density, combine analysis and determine geometric mean diameter; and (9) make a matrix-geometric mean diameter of all patches along the stream reach for comparison after impact. (Davison-IPA)

W79-07503

EFFECTS OF THERMAL DISCHARGE ON AQUATIC INSECTS IN THE TENNESSEE VALLEY.
Tennessee Valley Authority, Muscle Shoals, AL. Div. of Environmental Planning.
K. J. Tennesson, and J. L. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-295 415. Price codes: A04 in paper copy, A01 in microfiche. Interagency Energy/Environment Research and Development Program Report No. TVA/EP-78-09 and EPA-600/7-78-128, July 1978. 60 p, 24 fig, 9 tab, 12 ref. E-AP 80-BDR.

Descriptors: *Biology, *Animal growth, *Thermal stress, *Biorhythms, *Insects, *Growth stages, *Environment, Thermal pollution, Heat resistance,

Heated water, Hydrology, Limnology, Electric powerplants, Water pollution sources, Fecundity.

The burrowing mayfly, *Hexagenia bilineata* (Say), and the midge, *Clootianus* sp., were studied to determine their thermal tolerances, and to investigate their growth and emergence in the vicinity of Tennessee Valley Authority electric generating plants. The stages of the life cycle subject to thermal discharge from the electric generating plants were emphasized and include the eggs, the immatures (stationary or drifting), and the stage of emergence to the adult. The immature stages of both species showed great tolerance to thermal shocks of up to 20°C, a greatly reduced mean percentage of hatching resulted when eggs were subjected to a shock of 15°C, and egg development was limited at a constant temperature of 37°C. Nymphal growth was greater in areas where the thermal plume extends to the bottom during the winter and spring than in ambient areas. In late spring development in the ambient areas accelerated, and adults emerged at about the same date in both areas. No significant differences in size and fecundity were observed for *H. bilineata* females emerging from either area, but males emerging from thermal plume areas were larger than those emerging from ambient areas. The differences in mayfly biology were not expected to adversely affect the species in the study area. (Davison-IPA)

W79-07505

INFLUENCE OF A BARITE TAILINGS POND RUPTURE ON THE FISHES OF BIG RIVER, MISSOURI.
Maryland Univ., Frostburg. Appalachian Environmental Lab.

C. H. Hocutt, J. R. Stauffer, Jr., and P. A. Mills.
In: Surface Mining and Fish/Wildlife Needs in the Eastern United States, Proceedings of a Symposium, U.S. Fish and Wildlife Service, Morgantown, West Virginia, December 1978. Report No. FWS/OBS-78/81, p 177-189, 1978. 1 fig, 11 tab, 35 ref.

Descriptors: *Water pollution, *Environmental effects, *Fish populations, *Fish behavior, *Water pollution effects, Sampling, Aquatic environment, Turbidity, Water quality, Mine wastes, Strip mine wastes, Big River (Missouri), Mill Creek (Missouri), Buss Branch (Missouri).

The fish of the Big River, Mill Creek, and Buss Branch in Missouri were sampled at 27 stations during 1975 and 1976 to determine the effects of a barite tailings pond rupture on these fish. Twenty-two stations located above and below the discharge points of Buss Branch into Mill Creek and Mill Creek into Big River were sampled during 1975, and data obtained were compared with sampling results obtained just prior to the tailings pond rupture. This comparison showed that Mill Creek, where the tailings pond was located, suffered a nonselective stress and the fish community was reduced in numbers of species and specimens; the effects of the tailings pond rupture on the fish community of Big River were negligible. During the 1976 survey the 18 stations sampled did not necessarily correspond to those sampled in 1975, because the study objectives differed. Condition factors were calculated for several species to determine if the spill had long-term indirect effects on their healthiness. The fish populations of Mill Creek had recovered significantly in 1976, so that they were probably equivalent to those before the spill. (Davison-IPA)

W79-07507

INERTIA AND ELASTICITY AS A STREAM CLASSIFICATION SYSTEM: YOUGHIOGHENY RIVER CASE HISTORY EVALUATION.
Maryland Univ., Frostburg. Appalachian Environmental Lab.

J. R. Stauffer, Jr., C. H. Hocutt, M. L. Hendricks, and S. L. Markham.
In: Surface Mining and Fish/Wildlife Needs in the Eastern United States, Proceedings of a Symposium, U.S. Fish and Wildlife Service, Morgantown, West Virginia, December 1978. Report No. FWS/OBS-78/81, p 105-118, 1978. 1 fig, 6 tab, 28 ref.

Descriptors: *Rivers, *Eutrophication, *Mining wastes, *Environmental effects, *Watershed management, *Habitat improvement, *Youghiohony River, Sampling, Fish population, Streams, Monitoring, Fish migration, River systems, Wildlife management, Aquatic habitats, Ecosystems.

The feasibility of using a stream classification system based on the concepts of inertia and elasticity as applied to data obtained on the Youghiohony River is examined. Inertia, the ability of a stream to withstand a particular stress without eliciting a structural or functional change, can be calculated before a stress occurs. Elasticity is the ability of a system to recover once functional or structural change has occurred. Since only half the parameters used to calculate elasticity can be evaluated prior to stress because the type and intensity of a potential stress is unknown, inertia may be more useful in establishing a stream classification system. Structural and functional redundancy are major factors for calculating inertia. It is noted that functional redundancy was based only on tropic-level interaction. Structural redundancy, calculated by counting the number of species present in a particular family, implies functional redundancy. It was observed that areas with the highest inertia were not necessarily highest in elasticity. It is concluded that high inertia, low elasticity areas should be strictly managed as refugia. (Davison-IPA)

W79-07508

AN EMPIRICAL TRANSPORT MODEL FOR EVALUATING ENTRAINMENT OF AQUATIC ORGANISMS BY POWER PLANTS.
National Power Plant Team, Ann Arbor, MI.
For primary bibliographic entry see Field 7B.

W79-07515

OPPORTUNITIES FOR MAINTENANCE REHABILITATION OF RIPARIAN HABITATS: EASTERN UNITED STATES.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.

J. Cairns, Jr., J. R. Stauffer, Jr., and C. H. Hocutt.
In: Strategies for Protection and Management of Floodplain Wetlands and Other Riparian Ecosystems, National Symposium, December 11-13, 1978, Callaway Gardens, Georgia, Johnson, R. R., and McCormick, J. F., Eds., p 304-317, 1979. 10 tab, 31 ref. U.S. Dept. of Agriculture, Forest Service, Washington, DC. GTR-WO-12. E-(40-1) 4939.

Descriptors: *Riparian waters, *Maintenance, *Rehabilitation, *Ecosystems, Baseline studies, Biological properties, Chemical properties, Physical properties, Pollutants, Monitoring, Evaluation, Aquatic habitats, Aquatic organisms.

The maintenance of ecosystem quality requires the following basic components: (1) a baseline biological-chemical-physical study of the present condition; (2) a hazard evaluation based on knowledge of known potential pollutants entering the system and the estimated biological response to them; and (3) a biological-chemical-physical monitoring system designed for early warning of imminent harm. Difficulties encountered in the rehabilitation of an ecosystem include: (1) the original condition may not be known, (2) the ecological means of rehabilitation may not be possible or understood, (3) the cost may be prohibitive, and (4) a species may have been genetically altered after a long exposure to a man-made phenomenon. Two examples in which society's resistance to ecosystem rehabilitation was overcome are discussed. The characteristics of ecosystem vulnerability include inertia, the ability of a system to resist displacement of structural and functional characteristics, and elasticity which is the ability to recover from damage. Calculations of inertia indices and elasticity indices are presented. All of the parameters suggested can be used to calculate the inertia index, but the practical use of the elasticity index is limited by the lack of present information on dispersal rates of fishes and other aquatic organisms. It is concluded that maintenance and rehabilitation of riparian habitats in the eastern United States is possible with existing technology, and that water quality can be maintained through biological assessment and monitoring. (Davison-IPA)

W79-07518

LARVAL FISH WESTERN N. POWER PL.
Michigan State Research.

R. A. Cole.
Available from Service, Springfield, VA 22161 as PB-294 273. Price codes: A02 in paper copy, A01 in microfiche. Report No. EPA-600/3-79-014, February 1979. 19 p, 2 fig, 10 tab, 23 ref.

Descriptors: *Larvae, *Eutrophication, *Western, *Sampling, *Fish establishment.

Quantitative Lake Erie are discussed plankton net the coastal dilute, shifting were conducted efforts water column species near the bottom throughout that represent the effective Depth, turbidity from shore during daylight in flooded contrast with further offsh spawning sites idly disperse sampling in revealed certain to entrainment than yellow (Davison-IPA)

W79-07519

EFFECTS OF TAILINGS ON A California 1975 Lab.
For primary bibliographic entry see Field 7B.

W79-07523

AQUATIC TIONS ASH OHIO, AP WATER-QUALITY, STATE UNIV. Lakes Lab. R. K. Wyett, Army Engineer Vicksburg, July 1978. 30 p.

Descriptors: *Sediments, *Material, *Aquatic organisms.

An investigation of dredged aquatic and in Lake Erie through Sediments were release of n August 1977 water column ambient properties within material. In dissipated in benthic environments of ch conditions of erosion. The

Effects Of Pollution—Group 5C

W79-07518

LARVAL FISH DISTRIBUTION IN SOUTH-WESTERN LAKE ERIE NEAR THE MONROE POWER PLANT,
Michigan State Univ., East Lansing. Inst. of Water Research.
R. A. Cole.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-286 629, Price codes: A05 in paper copy, A01 in microfiche. Report No. EPA-600/3-78-069, July 1978. 73 p, 3 fig, 10 tab, 23 ref, 1 append. R804517010.

Descriptors: *Fish populations, *Fish migration, *Larvae, *Entrainment, *Electric power production, *Western Lake Erie, Environmental effects, Sampling, Equipment, Plankton nets, Ecosystems, Fish establishment, Density, Turbidity, Turbulence.

Quantitative sampling of larval fish in western Lake Erie and the sampling techniques employed are discussed. Daytime and nighttime tows of 1-m plankton nets were used to sample distributions in the coastal zone. Here, the larvae occur in very dilute, shifting, aggregated concentrations. Studies were conducted to contrast day and night sampling efforts and densities in different levels of the water column. The larvae of all abundant fish species near the Monroe Powerplant concentrated near the bottom during the day and dispersed throughout the water column at night, implying that representative daytime sampling depends on the effectiveness of the gear next to the bottom. Depth, turbidity and turbulence vary with distance from shore and could influence gear effectiveness during daytime studies. Larval fish were sampled in flooded tributary valleys and backwaters to contrast with samples from the beach front and further offshore. Pro larvae were concentrated near spawning sites; larvae reaching the lake were rapidly dispersed by currents. Density and mortality sampling in the powerplant cooling system revealed certain larval species were more vulnerable to entrainment: gizzard shad were more vulnerable than yellow perch, white bass, carp, and goldfish. (Davison-IPA)
W79-07519

EFFECTS OF SUSPENDED DREDGED MATERIAL ON AQUATIC ANIMALS,
California Univ., Bodega Bay. Bodega Marine Lab.

For primary bibliographic entry see Field 5E.
W79-07523

AQUATIC DISPOSAL FIELD INVESTIGATIONS ASHTABULA RIVER DISPOSAL SITE, OHIO, APPENDIX C, INVESTIGATION OF WATER-QUALITY AND SEDIMENT PARAMETERS,
State Univ. of New York Coll. at Buffalo. Great Lakes Lab.

R. K. Wyeth, and R. A. Sweeney.
Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. Technical Report D-77-42, July 1978. 344 p, 3 append, 15 tab, 106 fig, 33 ref.

Descriptors: *Aquatic environment, *Lake Erie, *Sediments, *Water quality, Benthos, *Dredged material, *Ashtabula River.

An investigation to evaluate impacts of the release of dredged material on chemical aspects of the aquatic and benthic environments was conducted in Lake Erie off Ashtabula, Ohio, from June 1975 through September 1976. Samples and measurements were taken prior to, during, and after the release of materials from a hopper dredge during August 1975 and May 1976. The impact on the water column was short-lived with a return to ambient pre-disposal conditions for most parameters within 90 minutes after release of dredged material. Impacts on interstitial water generally dissipated in less than 90 days after disposal. The benthic environment was the most affected in terms of chemical changes. A return to predisposal conditions did occur within a year primarily due to erosion. There was no evidence of heavy metals

accumulations by either benthos or fish as a consequence of disposal of dredged material. A Standard Elutriate Test preparation time dependency study also was done. This investigation resulted in some suggested changes for improving reliability. (WES)
W79-07525

RESPONSE OF PHYTOPLANKTON AND BACTERIA TO WATER QUALITY IN THE CHOWAN RIVER, NORTH CAROLINA,
North Carolina State Univ. at Raleigh. Dept. of Botany.

O. C. Boody, IV.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 301, Price codes: A08 in paper copy, A01 in microfiche. MS Thesis, 156p, 1979. 26 fig, 2 tab. OWRT B-091-NC (1), 14-34-0001-6104.

Descriptors: *Phytoplankton, Water quality, *Algal growth, Algal blooms, Nitrogen, Organic phosphorus, *Primary productivity, Chowan River.

Simultaneous in situ measurements of primary productivity and heterotrophic activity using a new apparatus indicated daily and seasonal variations in activity. Using a single, uniformly labeled substrate (14C-glucose) at tracer levels, diurnal heterotrophic activity was measured as percentage uptake and mineralization. Primary productivity was measured using labeled (14C)NaHCO₃ at four hour intervals throughout the daily photic period. Daily variation in peak bacterial activity was as much as 0.36% hr⁻¹ to 13.8% hr⁻¹. Variation in bacterial activity was also observed on a seasonal basis. Activity during summer and spring was generally highest during the hours before or just after sunrise. Autumn and winter activity, although lower than summer and spring, was at higher levels during the photic period. Primary productivity ranged from 2.73 x 10⁻³ g C l⁻¹ hr⁻¹ to 2.51 u g C l⁻¹ hr⁻¹ at Tunis, N.C. and from 3.04 u g C l⁻¹ hr⁻¹ to 6.66 u g C l⁻¹ hr⁻¹ at Colerain, N.C. Algal productivity was generally skewed with peak activity during early morning. Population studies of algal and bacteria were undertaken at both Tunis and Colerain. Both populations were highest in summer and spring. The dominant algal groups during the summer were Diatoms at Tunis and Blue-greens at Colerain. Nutrient analyses indicated that winter buildup of inorganic N and inorganic P occurs and these elements are available for spring blooms when water temperature and light conditions become conducive. Multiple linear regressions of algae and bacteria populations vs. nutrient and some physical data were run to detect correlations. (Kiger-North Carolina)
W79-07568

SCREENING AQUATIC ECOSYSTEMS FOR MUTAGENS WITH FERN BIOASSAYS,
Massachusetts Univ., Amherst. Dept. of Botany.
For primary bibliographic entry see Field 5A.
W79-07588

BACTERIAL SUPPRESSION OF CHLORELLA BY HYDROXYLAMINE PRODUCTION,
Massachusetts Univ., Waltham. Dept. of Environmental Sciences.

P. S. Berger, J. Rho, and H. B. Gunner.
Water Research, Vol. 13, p 267-273, 1979. 6 fig, 1 tab, 31 ref. OWRT B-058-MASS(2). 14-34-0001-7161.

Descriptors: *Algal control, Aquatic microbiology, *Biocontrol, *Chlorella, Algal toxins, Bacteria, Eutrophication, Nitrification, Hydroxylamine.

An actively nitrifying *Arthrobacter* sp. isolated from a lake inhibited the growth of *Chlorella vulgaris*. This was found to be due to hydroxylamine released by the bacterium during the oxidation of ammonium or other reduced nitrogen compounds. Plates containing Plate Count Agar streaked with *Arthrobacter* accumulated 5 micrograms ml⁻¹ hydroxylamine-N. *Chlorella* was sensitive to less than 0.24 micrograms ml⁻¹ hydroxylamine-N. Non-nitrifying bacterial isolates of lacustrine origin did not

demonstrate inhibiting activity. Results indicate that nitrifying microorganisms may thus affect the population dynamics of algae in eutrophic lakes. (Godfrey-Mass)
W79-07589

DRINKING WATER AND HEALTH. PART I, CHAPTERS 1-5. A REPORT OF THE SAFE DRINKING WATER COMMITTEE,
National Academy of Sciences, Washington, DC.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-270 422, Price codes: A25 in paper copy, A01 in microfiche. 1977. 582 p, 5 fig, 38 tab, 962 ref.

Descriptors: *Potable water, Water quality standards, *Microorganisms, *Suspended solids, *Solutes, *Public health, Toxicity, Water pollution effects, Lead, Arsenic compounds, Pesticides, Radioisotopes, Radiation, Chlorination.

A literature review is presented of the effects of the constituents of drinking water on human health. The risk to man was evaluated on the basis of both epidemiological studies and studies of toxicity in laboratory animals. Five classes of contaminants were investigated: microorganisms, particulate matter, inorganic solutes, organic solutes, and radionuclides. Chlorine has controlled microorganisms to an appreciable extent (10,000 cases of waterborne enteric disease were confirmed in 1975), but there are questions concerning toxicity of by-products and residuals in the distribution system. Fine particles are suspended in drinking water which may decrease the efficiency of disinfection, act as contaminant carriers, or perhaps produce toxic effects. Health effects associated with 22 inorganic solutes were reviewed, and reexamination of the current standards for lead, arsenic, and selenium was recommended. One hundred and twenty nine organic compounds including 55 pesticides were examined. Lifetime exposure risk of 22 known or suspected carcinogens was estimated, and an Acceptable Daily Intake (ADI) was calculated for 45 compounds judged potentially toxic but not carcinogenic. Radiation associated with water supplies is usually a small proportion of background radiation, but in a few cases, radium can reach concentrations that pose a higher risk of bone cancer. (See also W79-07591) (Small-FIRL)
W79-07590

DRINKING WATER AND HEALTH PART 2, CHAPTERS 6 AND 7. A REPORT OF THE SAFE DRINKING WATER COMMITTEE,
National Academy of Sciences, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-270 423, Price codes: A23 in paper copy, A01 in microfiche. 1977. 508 p.

Descriptors: *Toxins, *Water sampling, *Pollutant identification, Chemical analysis, Toxicity, Water quality control, Pesticide toxicity, Water quality standards, Water supply, Insecticides, Herbicides, *Potable water, *Public health.

The potentially harmful effects on human health of some of the impurities in drinking water were studied. The organic contaminants identified in drinking water comprise a small fraction of the total organic matter present. Although approximately 90% of the volatile organics in drinking water have been identified and quantified, these represent no more than 10% of the total organic material. Only 5-10% of the non-volatile organic compounds, have been identified which comprise the remaining 90% of the total organic material in water. A cautious approach must be adopted when dealing with potentially harmful chemicals. For many of the organic compounds identified in drinking water, virtually no toxicity data is available. To determine those agents for which data is most needed, the following assignment of priorities was made: (1) The relative compound concentration and the number of persons likely to be exposed; (2) The number of water systems in which the compounds occur; (3) Positive response to in vitro (a) mutagenic screening systems; and (b) carcinogen pre-screening; (4) Similarity of a compound's chemical structure to others having defined toxic

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properties; (5) Relationship of dose from water to total body burden. (See also W79-07590) (Fortin-Florida)
W79-07591

MICROBIOLOGICAL STUDIES ON THE NITROGEN CYCLE IN AQUATIC ENVIRONMENTS - V NITROGEN METABOLISM IN THE GOLDFISH CULTURING POND,
Kyoto Univ., (Japan). Research Inst. for Food Science.

For primary bibliographic entry see Field 5B.
W79-07592

PSEUDODACTYLOGYRUS MICRORCHIS (MONOGENEA) ON THE GILLS OF CULTURED EELS-III EXPERIMENTAL CONTROL BY TRICHLORFON,
Fukui Prefecture Fisheries Experimental Station, Tsuruga (Japan).
R. Imada, and K. Muroga.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 45, No. 1, p 25-29, 1979. 3 fig, 1 tab, 4 ref.

Descriptors: *Animal parasites, *Worms, *Eels, *Pseudodactylogyrus, *Trichlorfon, *Formalin, Pesticides, Pesticide toxicity, Chlorinated hydrocarbon pesticides, Chlorides, Toxicity, Growth stages, Aquaculture, Fish parasites, Bioassay, Fish diseases, Fish, Fish hatchery.

In the first experiment, the effects of trichlorfon, formalin and sodium chloride baths on the control of *Pseudodactylogyrus microrchis* on eels (*Anguilla anguilla*) were studied. 0.5 ppm-24 hour-bath of trichlorfon proved to be potentially practical in both effectiveness and harmlessness. In the second experiment, the effective method of treatment with 0.5 ppm-24hour trichlorfon bath was examined. A double 0.5ppm-24 hour-bath of trichlorfon with an adequate interval was confirmed to be completely effective for the control of the worm. The second bath was found to be indispensable, because the eels became reinfested with the young forms hatched from eggs which were laid during the first bath. The interval between the first bath and the second bath depends on the time required for hatching of the eggs. A 3 day interval proved adequate at the experimental water temperature of 25.5-28°C. (Deal-EIS)
W79-07593

GROWTH AND PRODUCTION OF AMPHIPODS GAMMARUS OLIVII AT DIFFERENT TEMPERATURES,
Akademiya Nauk USSR, Sevastopol. Dept. of Physiology of Aquatic Animals.
G. I. Abolmasova.
The Soviet Journal of Marine Biology, Vol. 4, No. 3, p 655-659, 1978. 1 fig, 3 tab, 14 ref. (Translated from Russian).

Descriptors: *Water temperature, *Growth rates, *Productivity, *Amphipoda, *Gammarus, Animal physiology, Growth stages, Crustaceans, Size, Mathematical studies, Biomass, Seasonal, Respiration, Animal metabolism.

The equation of dependence between the mass of *Gammarus olivii* before and after moulting at 5, 10, and 20°C is calculated. It is shown that the absolute value of body mass increment during moulting is in direct proportion to the mass up to moulting. The empirical growth curves are S-shaped. The curves constructed on the basis of observations are in good agreement with the growth curves calculated in relation to physiological indicators. The author demonstrates that with the increase of temperature the specific growth rate increases accordingly. (Deal-EIS)
W79-07595

REVIEW OF OXYGEN DEPLETION AND ASSOCIATED MASS MORTALITIES OF SHELLFISH IN THE MIDDLE ATLANTIC BIGHT IN 1976,
National Marine Fisheries Service, Highlands, NJ, Sandy Hook Sport Fisheries Marine Lab.

F. W. Steimle, and C. J. Sindermann.
Marine Fisheries Review, Vol. 40, No. 12, p 17-26, 1978. 6 fig, 41 ref.

Descriptors: *Mortality, *Clams, *Oxygen sag, *Middle Atlantic Bight, Eutrophication, Oxygen, Lobsters, Migration patterns, Migration, Fish migration, Animal behavior, Commercial shellfish, Biological communities, Waste disposal, Weather data, Weather patterns, Continental shelf.

In summer and autumn of 1976, mass mortalities of shellfish occurred in a 165-km long corridor of severe oxygen depletion paralleling the New Jersey coast from 5 to 85 km from shore. Mortalities of surf clams, *Spisula solidissima*, the most severely affected species, were estimated in excess of 140,000 t. Alteration of normal migration patterns of lobsters and several species of finfish was also noted. A series of anomalous meteorological and hydrological events (particularly early warming of surface waters resulting in early thermocline development, and a massive shelf-wide phytoplankton bloom) superimposed on an already stressed coastal area, was considered to be responsible. The occurrence is particularly significant because the continental shelf of the Middle Atlantic Bight, from Cape Cod to Cape Hatteras on the east coast of the United States, contains the largest known stocks of ocean shellfish of any comparable coastal area of North America. (Deal-EIS)
W79-07596

ELEMENTAL DISTRIBUTION IN RELATION TO SKIN NECROSES OF MARINE FLATFISHES FROM THE ENGLISH CHANNEL,
Westfield Coll., London (England). Dept. of Zoology.
P. F. Newell, T. C. Appleton, B. E. Brown, and J. W. Carnwarth.
Marine Biology, Vol. 51, p 93-99, 1979. 2 fig, 4 tab, 31 ref.

Descriptors: *Industrial wastes, *Fish diseases, *Fish parasites, *Skin necrosis, *Fin lesions, *Flatfish, *Limanda, *Pleuronectes, *Platichthys, *Solea, *Tissue analysis, Animal pathology, Fish populations, Chemical analysis, Spectroscopy, Chemical wastes, Trace elements, Metals, Heavy metals, Sodium, Magnesium, Aluminum, Phosphorus, Sulfur, Chlorine, Potassium, Calcium, Iron, Copper, Zinc, Chromium, Water chemistry, Cadmium, Cobalt, Manganese.

It has been suggested that industrial waste discharges are associated with the occurrence of fin damage and skin lesions. A mixed population of diseased and healthy flatfish consisting of *Limanda limanda*, *Pleuronectes platessa*, *Platichthys flesus* and *Solea solea* were collected from an industrialised area (Calais, France) and were compared with diseased and healthy *L. limanda* caught in a non-industrialised area (Brixham, England). Analysis of skin samples from necrosed and healthy fish by X-ray microanalysis and atomic absorption spectroscopy has shown that no elemental accumulation occurs either in necrosed fish, or fish from an industrialized area. The fish from Calais were heavily infested with the ectoparasitic copepod *Lepeophtheirus pectoralis* (O.F. Muller) and, although few were found on fish from Brixham, it is unlikely that this infestation was related to the discharge of industrial effluents. (Deal-EIS)
W79-07597

METHYLMERCURY: REPRODUCTIVE AND BEHAVIORAL EFFECTS ON THREE GENERATIONS OF MALLARD DUCKS,
Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center.
G. H. Heinz.
Journal of Wildlife Management, Vol. 43, No. 2, p 394-401, 1979. 6 tab, 25 ref.

Descriptors: *Mallard duck, *Mercury, *Toxicity, *Methylmercury, *Bird eggs, *Tissue analysis, *Bioaccumulation, Heavy metals, Animal behavior, Animal physiology, Reproduction, Growth stages, Hatching, Nests, Path of pollutants.

Three generations of mallard ducks were fed either a control diet or a diet containing 0.5 ppm mercury

in the form of methylmercury. The levels of mercury in adult tissues and eggs remained about the same over 3 generations. The methylmercury diet had no effect on adult weights or weight changes during the reproductive season. Females fed a diet containing 0.5 ppm mercury laid a greater percentage of their egg outside their nestboxes than did controls, and also laid fewer eggs and produced fewer ducklings. Methylmercury in the diet appeared to result in a small amount of eggshell thinning. Ducklings from parents fed methylmercury were less responsive than controls to tape-recorded maternal calls, but were hyper-responsive to a frightening stimulus in avoidance tests; there were no significant differences in locomotor activity in an open-field test. (Deal-EIS)
W79-07598

EFFECT OF HIGH CONCENTRATIONS OF PETROLEUM AND PHENOL ON THE METABOLISM OF NUCLEIC ACIDS OF ALGAE MACROPHYTES,
Institute of Biology of Southern Seas, Sevastopol (USSR). Dept. of Marine Sanitary Hydrobiology.
I. A. Divavin, O. G. Mironov, and I. M. Tsybmal.
The Soviet Journal of Marine Biology, Vol. 4, No. 1, p 542-544, 1978. 1 tab, 6 ref. (Translated from Russian).

Descriptors: *Biochemistry, *Toxicity, *Phenols, *Oil, Oil spills, *Nucleic acids, *DNA, *RNA, Chlorophyta, Rhodophyta, Phaeophyta, Marine algae, Metabolism, Chemical reactions, Chemical analysis, *Plant physiology.

The authors describe the change in content of free nucleotides RNA and DNA in green (*Enteromorpha intestinalis*, *Bryopsis plumosa*), red (*Callithamnion corymbosum*), and brown (*Scytosiphon lomentaria*) algae under the effect of petroleum and phenol taken separately and combined in concentrations of 0.5 and 0.2-0.5 ml/liter and g/liter, respectively. It is found that petroleum is a stronger toxin than phenol. Different reactions of different species of algae to the effect of toxicants are discovered. The authors hypothesize that the changes in free nucleotide content are due to the disruption of biosynthesis of nucleotides and nucleic acids. (Deal-EIS)
W79-07599

UPTAKE OF METHYLAMINE (AN AMMONIUM ANALOGUE) BY MACROCYSTIS PYRIFERA (PHAEOPHYTA),
California Inst. of Tech., Corona Del Mar. Kerckhoff Marine Lab.
For primary bibliographic entry see Field 5B.
W79-07600

AVAILABILITIES OF THREE IRON COMPOUNDS AS DIETARY IRON SOURCES FOR RED SEA BREAM,
Kyushu Univ., Fukuoka, (Japan). Fisheries Research Lab.
S. Sakamoto, and Y. Yone.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 45, No. 2, p 231-235, 1979. 5 tab, 14 ref.

Descriptors: *Fish diets, *Iron, Fish hatchery, *Bream, *Chrysophrys, *Tissue analysis, Chlorides, Fish management, Aquaculture, Biochemistry, Amino acids, Absorption, Chemical analysis, Chelators, Acids, Enzymes.

Two experiments were conducted to compare the availability of ferrous chloride, ferric chloride, and ferric citrate as the iron sources in the diet for red sea bream, *Chrysophrys major*. Iron contents of the test diets were adjusted to approximately 15 mg per 100 g of diet in experiment I, and 20 mg per 100 g in experiment II. Fish were reared on the test diets at 25 degrees C over a 73-day period (Exp. I) and over a 90-day period (Exp. II). At the end of the feeding trial, hematological examinations and chemical analyses of the blood serum were conducted. At the 15 mg Fe per 100 g diet level, fish fed the diet supplemented with ferric citrate showed a slight iron deficiency anemia, but fish fed the diets with supplemental ferrous chloride and ferric chloride did not. On the other hand,

at the 20 mg Fe found in the blood, it was concluded that ferric chloride deficiency and 100 g diet, and 20 mg Fe per 100 g diet.
W79-07602

CORRELATION OF MAGNETIC FIELDS FOR VALUES OF SUBSTANCE PROCTER AND GALE TECHNICAL
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W79-07603

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Descriptors: *Sewage effluents, Chlorinated hydrocarbons, Chemical wastes, Chemical analysis, Bottom sediments.

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ACCUMULATION OF SALIN
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Descriptors: *Chains, *Biochemistry, *Pollutants, *Animal metabolism, *Absorption, *Disactivity, 1

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Effects Of Pollution—Group 5C

at the 20 mg Fe per 100 g diet level, no anemia was found in the ferric citrate group. Therefore, it is concluded that the amount of ferrous chloride and ferric chloride required for the prevention of iron deficiency anemia corresponds to 15 mg Fe per 100 g diet, and that of ferric citrate corresponds to 20 mg Fe per 100 g diet. (Deal-EIS) W79-07602

CORRELATIONS BETWEEN DAPHNIA MAGNA AND FATHEAD MINNOW (PIMEPHALES PROMELAS) CHRONIC TOXICITY VALUES FOR SEVERAL CLASSES OF TEST SUBSTANCES.

Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.

For primary bibliographic entry see Field 5A.

W79-07603

DIELDRIN POLLUTION IN THE RIVER HOLME CATCHMENT, YORKSHIRE, MANCHESTER UNIV. (ENGLAND).

L. Brown, E. G. Bellinger, and J. P. Day. Environmental Pollution, Vol. 18, p 203-211, 1979. 1 fig, 3 tab, 18 ref.

Descriptors: *Dieldrin, *Pesticide residues, *Sewage effluents, *Textile industry, Pesticide kinetics, Chlorinated hydrocarbon pesticides, Organic compounds, Path of pollutants, Industrial wastes, Chemical wastes, Textiles, Water chemistry, Bottom sediments, Particle size.

Dieldrin concentrations were measured during 1976 and 1977 in the River Holme and some of its tributaries, Yorkshire, England. The presence of dieldrin arises from its use as a mothproofing in the textile industry. Concentrations were measured from both water and sediment samples from each site. The highest levels of dieldrin were found below sewage works outfalls as the textile mills were discharging their effluent to sewer, not direct into the river. Stations above sewage outfalls had lower concentrations. Less than 30% of the dieldrin was associated with particles of less than 0.7 millimicrons in diameter. Concentrations of dieldrin in this river catchment were thought to be high enough to have a biological effect and this aspect was briefly discussed. (Deal-EIS) W79-07604

ACCUMULATION OF CADMIUM BY ARTEMIA SALINA.

Queen Mary Coll., London (England). Dept. of Zoology and Comparative Physiology. J. R. Jennings, and P. S. Rainbow.

Marine Biology, Vol. 51, p 47-53, 1979. 2 fig, 2 tab, 7 ref.

Descriptors: *Brine shrimp, *Cadmium, *Food chains, *Bioaccumulation, Tissue analysis, Path of pollutant, Heavy metals, Animal physiology, Animal metabolism, Chemical analysis, Digestion, Absorption, Phytoplankton, Crabs, Tracers, Radioactivity, Techniques, Radioisotopes.

The relative importance of accumulation of cadmium by *Artemia salina* directly from solution and from ingested food has been studied at 3 cadmium concentrations (0.1, 1 and 10 ppm) under controlled experimental conditions. At each cadmium concentration, *A. salina* were exposed to cadmium in 4 ways; in solution; in solution with the presence of latex 'food' particles; in solution with cadmium-rich *Dunaliella tertiolecta* as a food source; and to cadmium-rich *D. tertiolecta* alone. Net accumulation of cadmium by *A. salina* continued throughout 5 days exposure under all 4 conditions. When the brine shrimp were removed to cadmium-free conditions, their accumulated cadmium concentrations declined and levelled off to a stabilised plateau after 10 days. From consideration of these stabilised levels it was shown that at least 30% of cadmium accumulation directly from solution occurs via uptake through the alimentary tract. At lower cadmium exposures uptake from food is the major route for cadmium accumulation, but at higher exposures the cadmium-saturated food source displaced cadmium-rich water from the gut and therefore actually inhibited cadmium accumu-

lation. This study, therefore, concludes that the food chain will be the major source of cadmium as long as the previous trophic level has the ability to accumulate the metal to such an extent as to make it more available to the consumer than by direct uptake from seawater. (Deal-EIS) W79-07605

TOXICITY OF CADMIUM CHLORIDE AND LEAD NITRATE TO CHIRONOMUS TENTANS LARVAE.

Vikram Univ., Ujjain, (India) School of Studies in Zoology.

H. S. Rathore, P. K. Sanghvi, and H. Swarup. Environmental Pollution, Vol. 18, p 173-177, 1979. 1 tab, 17 ref.

Descriptors: *Cadmium, *Lead, *Toxicity, *Diptera, *Tissue analysis, *Textile industry, Chlorides, Nitrates, Heavy metals, Larval growth stage, Food chains, Fish food organisms, Chemical wastes, Pulp wastes, Protein.

Chironomid larvae form an important link in aquatic food chains. Effluents from textile and pulp mills contain cadmium and lead salts which are dangerous to chironomid larvae, an important fish food. Toxicities of cadmium chloride and lead nitrate were studied under experimental conditions and the mean survival time and LD100 values were calculated. The LD100 values were 20 and 70 ppm for cadmium chloride and lead nitrate, respectively. Results suggest that following poisoning by CdCl₂ the total protein contents of the chironomid larvae decrease. This may diminish the nutritive value of these larvae as fish food. Qualitative analysis of larvae following exposure to CdCl₂ and Pb(NO₃)₂ showed that these heavy metals were taken up by the chironomids. (Deal-EIS) W79-07606

EFFECT OF METHAMIDOPHOS ON THE GROWTH RATE AND ESTERASE ACTIVITY OF THE COMMON CARP CYPRINUS CARPIO L.

Malaya Univ., Kuala Lumpur (Malaysia). Dept. of Zoology.

Y. N. Chin, and K. I. Sudderuddin. Environmental Pollution, Vol. 18, p 213-219, 1979. 2 fig, 2 tab, 12 ref.

Descriptors: *Carp, *Growth rates, *Enzymes, *Toxicity, *Methamidophos, *Carbaryl, *Lindane, Tissue analysis, *Acetylcholinesterase, *Carboxylesterase, Diquat, Fry, Poisons, Inhibitors, Fish physiology, Animal metabolism, Insecticides, Fish behavior.

The acute toxicity of methamidophos and three other compounds to fingerlings of the common carp was determined. The 96-h LC50 values were 68 mg/litre for methamidophos, 1.7 mg/litre for carbaryl, 0.21 mg/litre for lindane and 50 mg/litre for diquat. The acetylcholinesterase (AChE) and carboxylesterase (CarE) activities of the brain and liver were monitored over six weeks in fish poisoned with sublethal doses of methamidophos. Brain CarE was more sensitive than AChE, but for the liver the reverse was true. In either case the degree of enzyme inhibition increased with increasing insecticide concentrations in the water. After exposure to methamidophos at 20 mg/litre for 48 h liver AChE and CarE recovered faster than those of the brain. For both organs CarE recovered faster than AChE. At sublethal doses methamidophos affected the growth rate of the fish but no direct relationship between growth and insecticide concentrations could be established. (Deal-EIS) W79-07607

CHRONIC LEAD POISONING IN A HERD OF MUTE SWANS.

MAFF Veterinary Investigation Centre, Loughborough (England).

V. R. Simpson, A. E. Hunt, and M. C. French. Environmental Pollution, Vol. 18, p 187-202, 1979. 10 fig, 4 tab, 17 ref.

Descriptors: *Lead, *Toxicity, *Mute Swan, *Mortality, *Tissue analysis, *Bioaccumulation,

*Anemia, Swans, Waterfowl, Poisons, Heavy metals, Iron, Zinc, Animal pathology, Animal physiology, Path of pollutants, Chemical analysis, Weight.

Lead poisoning due to the ingestion of lead fishing shot was shown to be the cause of death of a number of mute swans *Cygnus olor*. The area in which they were feeding was shown to be heavily contaminated with fishing shot. The results of clinical, histopathological, haematological and analytical examinations are reported. The kidneys of the dead birds contained from 350 to 6650 micrograms/g DM of lead and blood lead levels in the remainder of the herd were greatly elevated, rising to 3290 micrograms/100ml. Consistently elevated liver levels of iron and zinc and a marked loss of body weight were all directly proportional to the increase in kidney lead concentration. (Deal-EIS) W79-07608

METAL CONTENTS OF THE TWO MARINE ALGAE FOUND ON IRON ORE TAILINGS.

Chinese Univ. of Hong Kong. Dept. of Biology.

For primary bibliographic entry see Field 5B.

W79-07609

LETHAL AND SUBLETHAL EFFECTS OF BINARY MIXTURES OF CYANIDE AND HEXA-VALENT CHROMIUM, ZINC, OR AMMONIA TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS) AND RAINBOW TROUT (SALMO GAIRDNERI).

Minnesota, Univ., St. Paul. Dept. of Entomology, Fisheries, and Wildlife.

S. J. Broderius, and L. L. Smith, Jr. Journal of the Fisheries Research Board of Canada, Vol. 36, p 164-172, 1979. 1 fig, 2 tab, 31 ref.

Descriptors: *Toxicity, *Minnows, *Rainbow trout, *Chemical properties, *Cyanide, Zinc, Chromium, Bioassay, Mortality, Ammonia, Fish physiology, Growth rates, Chemical reactions, Mathematical models, Juvenile growth stage.

Various models have been proposed to predict the combined interactive effect on fish of mixtures of poisons from separate toxicities of individual substances. The success of these models was tested, using data describing the lethal and sublethal effects of individual substances or binary mixtures of HCN and Cr(VI), Zn(II), or ammonia to the fathead minnow and rainbow trout. Using the strictly additive toxic unit and additive index approach, it was determined from log-dosage mortality curves that the Zn-HCN and ammonia-HCN mixtures were more acutely toxic and Cr-HCN less toxic than predicted. The concentration and response addition models, which have been proposed for toxicants whose joint action is similar or independent, respectively, could not be used to predict dosage-mortality curves for the HCN mixtures. Linear regression lines representing the growth response of fish to log concentration for toxicants alone and in binary combinations were not significantly different, thus, for the toxic substances tested, the sublethal joint action of individual toxicants was not predictable from existing models and, in most cases, no interaction was indicated. The interactive nature of toxicants may be a function of the concentrations tested causing different biological processes to be affected (e.g. mortality vs. growth), and therefore different responses to be measured. A need still exists for development of a valid multiple toxicity approach for evaluating and predicting the toxicity of chemical combinations. (Deal-EIS) W79-07610

EFFECT OF PHENOBARBITAL AND HEXO-BARBITAL TREATMENT ON LEPIDOCYPHALICHTHYS THERMALIS, A FRESH WATER FISH.

Marathwada Univ., Aurangabad (India). Dept. of Chemistry.

M. S. Kachole, S. S. Pawar, and A. G. Mahajan. Bulletin of Environmental Contamination and Toxicology, Vol. 21, p. 488-491, 1979. 1 fig, 12 ref.

Group 5C—Effects Of Pollution

L. thermalis were exposed to 1 ppm of either phenobarbital or hexobarbital for seven days. Relative liver weights and liver 9,000 g protein levels were found to be concomitantly decreased. Body weight, oxygen uptake and liver lipase activity did not show any considerable differences in treated untreated fishes. Brain cholinesterase activity was found to be decreased in fishes treated with phenobarbital and hexobarbital. (Deal-EIS) W79-07611

In the present study, short-term tests were done on each species alone and then full-life-cycle tests were performed on each species alone and then with the two together. The 96-h LC50 for *Asellus* was 2.69 microgram/l. HCN and for *Gammarus* was 1.69 microgram/l. The highest no-effect concentration on *Asellus* in the full-life-cycle test lies between 29 and 40 microgram/l. The no-effect concentration on *Gammarus* was between 16 and 21 microgram/l. When exposed together to low levels, the competitive advantage shifted from *Gammarus* to the normally passive *Asellus*. (DEAFIS)

W79-07612

Methylamine uptake in nitrogen-starved *Chlorella pyrenoidosa* follows Michaelis-Menten kinetics: maximum uptake is about 1.6 nmol/microM cells/min half-saturation occurs at 4 microM methylamine, and the slope in the range where uptake is proportional to concentration is 0.4 nmol microM⁻¹/min/microM. In cells grown in the presence of a non-limiting nitrogen concentration, methylamine uptake is directly proportional to concentration up to at least 0.5 mM, and the slope is 1/500 that for starved cells. Similar uptake kinetics have been reported for *Penicillium chrysogenum* and attributed to an inducible 'ammonium permease'. Apparently, a similar permease occurs in algae. (Deals)

RELATION BETWEEN TOXICITY AND ACCUMULATION OF VARIOUS CHLOROPHENOLS IN GOLDFISH,
Kyushu Univ., Fukuoka (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 5B.
W79-07614

Red sea bream, *Chrysophrys major*, were fed diets with and without supplemental magnesium (66 and 12 mg Mg per 100 g diet, respectively) over a 60-day period. No significant differences were recognized between the two groups in the following determinations: the growth rate, feed efficiency, condition factor, and hepatosomatic index; the hemoglobin content, hematocrit value, red blood cell count, mean corpuscular hemoglobin, mean corpuscular volume, mean corpuscular hemoglobin concentration, mean corpuscular diameter, percentage of immature erythrocytes, a number of lymphocytes and granulocytes per 1000 red blood cells, and content of magnesium in the whole blood; the blood serum levels of calcium inorganic phosphorus, and urea-N; the moisture, lipid, and glycogen content of the dorsal muscle and liver; and the ash, calcium, phosphorus, and magnesium content of the vertebrae. Furthermore, no pathological change was recognized in the organs, erythrocytes, and leucocytes of fish fed the diet without the magnesium supplement. From these findings, it appears that magnesium supplementation in the diet for red sea bream is not essential, when the magnesium exists at a level exceeding 12 mg per 100 g diet. (Deal-EIS)

W79-07615

The purpose of this paper is to report on the relationship between exposure time and cadmium toxicity to laboratory and field populations of *Daphnia galeata mendotae*, as summarized in a cadmium toxicity curve, and to derive a cadmium toxicity curve and to derive a cadmium application factor. The 96-h EC50 is 30 microg Cd/L and the 48-h EC50 is 40 microg Cd/L. The long-term effects of increased cadmium concentrations on relative carrying capacity for *D. galeata mendotae* populations, K, is represented by the equation $K = 1.0-0.065 \text{ Cd}$, and the corresponding chronic ECI is 0.15 microg Cd/L. (Deal-EIS)

coordination and balance, irregular swimming bouts, swollen stomachs and finally falling to the bottom followed by death. In the Zebra cichlids that out-lived lead toxicity, spermatogenesis and oogenesis occurred up to 300 ppm. Lead affected the survival of the fry. Lead also induced a number of lethal and non-lethal congenital malformations in the fry. (Deal-EIS)
W79-07617

CHEMICAL CONTAMINATION BY PCBS IN THE FISHES OF A FRENCH RIVER: THE FURANS (JURA),
Ecole Nationale Veterinaire de Lyon (France).
Lab. of Toxicology.
G. Keck, and J. Raffenot.
Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 689-696, 1979. 5 fig, 1 tab, 8 ref.

Descriptors: *Polychlorinated biphenyls, *Brown trout, *Bullheads, *Pesticide residues, *Tissue analysis, *Bioaccumulation, *Furans River(France), *Cyprinids, PCB, Salmonids, Chlorinated hydrocarbon pesticides, Pesticide kinetics, Path of pollutants, DDT, Size, Weight, Lipids, Chemical analysis, Water pollution effects.

Representative species of the fish population of the Furans River were analyzed for PCB content. The levels of PCBs found in the fishes were relatively high, much higher than the levels of organochlorine pesticides. The most striking fact is the high degree of accumulation by the barbel and the carp (Cyprinids) in comparison with the Salmonids, trout, and grayling. The distribution of PCBs between the organs varies according to the species; the liver always concentrates most; the gills and the eggs also contain high concentrations; the levels in the kidney and the muscle vary with the species. (Deal-EIS)

W79-07618

TRENDS IN APPLIED PHYCOLOGY WITH A LITERATURE REVIEW: SEAWEED FARMING ON AN INDUSTRIAL SITE.
Department of Marine Botany, Goteborg (Sweden).
For primary bibliographic entry see Field 5B.
W79-07619

COMPARISON OF TOXINS IN THREE ISOLATES OF GONYAULAX TAMARENSIS (DINOPHYCEAE),
Rhode Island Univ., Kingston.
For primary bibliographic entry see Field 5A.
W79-07620

**TOXICITY AND BIOACCUMULATION OF
HEXACHLOROCYCLOPENTADIENE
HEXACHLORONORBORNADIENE AND
HEPTACHLORONORBORNENE IN LARVAL
AND EARLY JUVENILE FATHEAD MIN-
NOWS, PIMEPHALES PROMELAS,**
Environmental Research Lab., Duluth, MN.
R. L. Spehar, G. D. Veith, D. L. DeFoe, and B. V.
Bergstedt.
Bulletin of Environmental Contamination and
Toxicology., Vol. 21, p 576-583, 1979, 3 tab, 21 ref.

Descriptors: *Chlorinated hydrocarbon pesticides, *Toxicity, *Minnows, *Tissue analysis, *Bioaccumulation, *Cyclodiene insecticides, Hexachlorocyclopentadiene, Pesticide toxicity, Pesticide kinetics, Chemical analysis, Chemical reactions, Chemical properties, Insecticides, Bioassay, Mortality, Fish physiology, Larval growth stage, Juvenile growth stage.

The purpose of this study was to determine the toxicity and bioaccumulation of hexachlorocyclopentadiene and selected derivatives using 30 day flow through tests with larval and early juvenile stages of the fathead minnow. Thirty-day exposures with larval and early juvenile fathead minnows showed that concentrations of 7.3, 38.4, and 40.0 micrograms/L and above of hexachlorocyclopentadiene, hexachloronorbodiene, and

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Toxicology

Descriptors: *Absorption, *Bioassay, *Benthos, *Seawater, *Pesticides, *Pathology, *Organic compounds

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The chronic effects of the insecticide on the snails was studied in the case of the most sensitive species, *Physa*, beyond the LD₅₀ (100 mg/l) and the sublethal toxic products were reduced in the water. The effect of the insecticide on the reproduction of the snails was studied. The product (100 mg/l) did not reduce the fertility of the snails and the incubation period was not disturbed by the insecticide. The two insecticides (EIS) were not found in the water.

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heptachloronorborene, respectively, would be deleterious to this species. The 96-h LC50 and 30-day LC50 values for these compounds, respectively, were: 7.0 and 6.7 micrograms/L, 188 and 123 micrograms/L, and 85.6 and 60.1 micrograms/L. Bioconcentration factors were uniformly low for hexachlorocyclopentadiene but were proportional to exposure concentration and for heptachloronorborene. (Deal-EIS) W79-07622

REMOBILIZATION OF SEDIMENT-ASSOCIATED PCBs BY THE WORM NEREIS DIVER-SICOLOR

International Lab. of Marine Radioactivity, Monte Carlo (Monaco). Oceanographic Museum. D. L. Elder, S. W. Fowler, and G. G. Polikarpov. Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 448-452, 1979. 1 fig, 10 ref.

Descriptors: *Polychlorinated biphenyls, *Worms, *Absorption, *Bottom sediments, *Nereis, *Depuration, *Bioconcentration, *Tissue analysis, Marine benthos, Sediments, Chlorinated hydrocarbon pesticides, Path of pollutants, Chemical analysis, Organic compounds, Animal metabolism.

In order to test the existence and degree of importance of remobilization of PCBs from sediments, the polychaete *Nereis diversicolor* was exposed to sediment containing 0.65 ppm PCB. The worms absorbed PCBs until equilibrium was reached in 40-60 days. The concentration factors were approximately 3.5. Following transfer to uncontaminated sediments the PCB content of the worms steadily decreased. It was theorized that the depuration rate was dependent on the PCB level in the sediments. (Deal-EIS) W79-07623

THE CHRONIC TOXICITY OF CARBARYL AND LINDANE TO THE FRESHWATER MOLLUSC LYMNEA STAGNALIS L. (TOXICITE CHRONIQUE DU CARBARYL ET DU LINDANE CHEZ LE MOLLUSQUE D'EAU LYMNEA STAGNALIS L.)

Paris-11 Univ., Orsay (France). Lab. de Zoologie. J. Seuge, and R. Bluzat. Water Research, Vol. 13, p 285-293, 1979. 4 fig, 5 tab, 20 ref. (English Abstract).

Descriptors: *Toxicity, *Insecticides, *Mollusks, *Lindane, Carbaryl, *Lymnea, *Embryogenesis, Freshwater snails, Growth rates, Larval growth state, Animal physiology, Animal metabolism, Fecundity, Fertility, Pesticide toxicity, Carbamate pesticides, Chlorinated hydrocarbon pesticides.

The chronic toxicity of the two insecticides to snails was studied from the hatching of the eggs. In the case of lindane, the rearing of larvae is impossible beyond a 2 mg/l concentration. With these two toxic products (1 or 2 mg/l) the shell growth is reduced in proportion to the doses. The shell calcification is clearly disturbed only by lindane. This product (1 mg/l) produces a decrease of the fecundity more evident than carbaryl (2 mg/l). The fertility of the eggs is reduced when they are laid and incubated in these toxic solutions from the 2 mg/l concentration. The embryogenesis is disturbed by lindane. An early intoxication by these two insecticides, compared with a late one, affects the biological parameters more severely. (Deal-EIS) W79-07624

BIOCONCENTRATION OF CHLORDANE BY THE GREEN ALGA SCENEDESMUS QUADRICAUDA

Toronto Univ. (Ontario). Faculty of Forestry. V. Glooschenko, M. Holdrinet, J. N. A. Lott, and R. Frank. Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 515-520, 1979. 1 tab, 20 ref.

Descriptors: *Scenedesmus, *Chlorinated hydrocarbon pesticides, *Chlordane, *Bioconcentration, Chlorophyta, Pesticide kinetics, Path of pollutants, Metabolism, Phytoplankton, Organic compounds, Chemical analysis, Aquatic algae, Biodegradation.

Results show a bioconcentration factor of 6,000 to 15,000 for cis and trans chlordane at all treatment levels after 24 hr. This is in contrast to a bioconcentration factor of 98,000 observed in the unbranched filamentous alga *Oedogonium*. The greater algal biomass represented by *Oedogonium* may have contributed to increased pesticide uptake. Our work shows the major isomers of technical chlordane are concentrated by *Scenedesmus* from initial environmental levels as low as 0.1 micrograms/L. The 0.1 micrograms/L level is approximately 1/100 of the water solubility of technical chlordane. The data indicate that bioconcentration was rapid, occurring within the first 24 hr. (Deal-EIS) W79-07625

ORGANOPHOSPHATE POISONING TO SOME FRESH WATER TELEOSTS - ACETYLCHOLINESTERASE INHIBITION

D.A.V. Coll., Muzaffarnagar (India). Pollution Relevant Research Lab. S. R. Verma, A. K. Tyagi, M. C. Bhatnagar, and R. C. Dalela. Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 502-506, 1979. 2 tab, 14 ref.

Descriptors: *Organophosphorus pesticides, *Pesticide toxicity, *Enzymes, *Acetylcholinesterase, *Tissue analysis, *Channa, *Cirrhina, *Malathion, Biochemistry, Chemical analysis, Insecticides, Freshwater fish, Fish physiology, Animal metabolism, Mortality, Inhibition, Water pollution effects.

The activity of AChE in the brain, liver and muscles of *Channa gachua* and *Cirrhina mrigala* was determined after exposure of fishes to sublethal concentrations of Zolene, Rogor and Malathion. A significant fall in the AChE activity has been observed after treatment in both the fishes. A progressive significant fall in the enzyme activity has been observed in all tissues with increased pesticide concentrations. The highest fall in the activity of this enzyme was observed in brain of *C. mrigala* after three days exposure to Malathion, while least in liver of *C. gachua* exposed for seven days in Rogor. (Deal-EIS) W79-07626

EFFECT OF INTERMITTENT CHLORINATION ON DEVELOPING ZEBRAFISH EMBRYOS (BRACHYDANIO RERIO)

Florida Inst. of Tech., Melbourne. Dept. of Biological Sciences. S. F. Yosha, and G. M. Cohen. Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 703-710, 1979. 3 fig, 3 tab, 24 ref.

Descriptors: *Chlorine, *Toxicity, *Embryonic growth stage, *Chlorination, *Zebrafish, Larval growth stage, Mortality, Ions, Calcium, Magnesium, Chlorides, Fish eggs, Fish physiology, Water quality, Water pollution effects.

The primary objective was to determine whether chlorine adversely affects the hatchability of freshwater fish embryos and to what extent, if any, chlorine toxicity is modified by the ionic composition of the water. Contrary to initial expectations, chlorine, even at a relatively high concentration (1 mg/mL total residual chlorine), was not toxic to developing zebrafish embryos prior to hatching. However, chlorine in the presence of a mild external ionic stress (CaCl₂ and MgCl₂) significantly reduced the number of embryos hatched. Chlorine was toxic to newly hatched larvae in all solutions tested, whereas no mortalities of the newly hatched larvae occurred in any of the solutions in the absence of chlorine. Once again ionic stress potentiated the effects of chlorine. (Deal-EIS) W79-07627

VESSEL-RELATED CONTAMINATION OF SOUTHERN CALIFORNIA HARBOURS BY COPPER AND OTHER METALS

Southern California Coastal Water Research Project El Segundo. D. R. Young, G. V. Alexander, and D. McDermott-Ehrlich.

Marine Pollution Bulletin, Vol. 10, p 50-56, 1979. 3 fig, 5 tab, 19 ref.

Descriptors: *Mussels, *Copper, *Paints, *Antifouling materials, *Tissue analysis, *Mytilus, Chemical analysis, Polychlorinated biphenyls, Silver, Cadmium, Chromium, Nickel, Lead, Tin, Zinc, Ships, Water pollution sources, Bioindicator.

A number of trace contaminants appear to be introduced to nearshore marine waters as a result of vessel-related activities. Such inputs are clearly reflected by elevated concentrations of these constituents in several tissues of the bay mussel *Mytilus edulis*. Comparative studies using this bioindicator suggest that harbour-related activities can be as important a source as coastal wastewater discharges in the contamination of nearshore marine ecosystems. (Deal-EIS) W79-07628

TEMPERATURE SELECTION AND ESTIMATED THERMAL ACCLIMATION BY RAINBOW TROUT (SALMO GAIRDNER) IN A THERMAL PLUME

Argonne National Lab., IL. S. A. Spigarelli, and M. M. Thommes. Journal of the Fisheries Research Board of Canada, Vol. 36, p 366-376, 1979. 5 fig, 3 tab, 38 ref.

Descriptors: *Rainbow trout, *Thermal pollution, *Water temperature, Heated water, Fish physiology, Animal metabolism, Adaptation, Size, Weight, Fish behavior, Lake Michigan, Nuclear powerplants, Cooling water, Water pollution effects.

Body temperatures of rainbow trout caught from a thermal discharge into Lake Michigan were used to determine selected temperatures and to estimate acclimation temperatures of this species under field conditions. Approximately 65-75% of the variability in body temperatures was related to water temperature (direct) and fish weight (inverse). Body temperatures increased with increases in discharge temperature, but the difference between body and ambient water temperatures decreased at high water temperatures. The modal body temperature of small fish was 19 degrees C, the final preferred temperature predicted for rainbow trout by some lab studies. The modal body temperature of large fish was 15 degrees C. Estimates of acclimation temperatures indicate that the majority of rainbow trout caught in this discharge area were acclimated to plume temperatures. Estimated acclimation temperatures exceeded ambient acclimation by as much as 10 degrees C for individual fish while group means ranged between 2 and 6 degrees C for individual fish while group means ranged from 2 and 6 degrees C over acclimation. (Deal-EIS) W79-07629

PCBS AND ORGANOCHLORINE INSECTICIDES IN OYSTERS FROM COASTAL LAGOONS OF THE GULF OF MEXICO, MEXICO

Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Ciencias del Mar y Limnologia. M. T. Rosales, L. A. V. Botello, H. Bravo, and E. F. Mandell. Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 652-656, 1979. 1 fig, 2 tab, 6 ref.

Descriptors: *DDT, *Polychlorinated biphenyls, *Oysters, *Pesticide residues, *Tissue analysis, *Crassostrea, *Chlordane, *Endosulfan, *Bioaccumulation, Dieldrin, Chlorinated hydrocarbon pesticides, Endrin, Gulf of Mexico, Lagoons, Coastal waters, Path of pollutants, Pesticide kinetics.

The purpose of this study was to determine baseline levels of PCBs and organochlorine insecticides in oysters (*Crassostrea virginica*) from coastal lagoons of the Gulf of Mexico. PCBs were found in all samples analyzed, indicating that these compounds are widely distributed. The concentration of PCBs ranged from 14 to 90 ppb, with the lowest

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values from very sparsely populated areas. DDT and dieldrin were present in most of the oysters analyzed, other organochlorine compounds were infrequently detected or found at low levels. DDT, with its analogs, occurred in concentrations ranging from 6 to 28 ppb. Dieldrin concentrations ranged from 0.03 to 1.1 ppb. (Deal-EIS) W79-07630

EFFECT OF PH ON TOXICITY OF KRAFT PULP AND PAPER MILL EFFLUENT TO SALMONID FISH IN FRESH AND SEAWATER. British Columbia Research Council, Vancouver. Div. of Applied Biology. D. J. McLeay, C. C. Walden, and J. R. Munro. Water Research, Vol. 13, p 249-254, 1979. 2 fig, 2 tab, 29 ref.

Descriptors: *Pulp wastes, *Hydrogen ion concentration, *Toxicity, *Acclimation, Bioassays, Rainbow trout, Coho salmon, Chemical wastes, Industrial wastes, Fish physiology, Mortality, Bleaching wastes, Juvenile growth stage, Salmonids, Water pollution effects.

In freshwater bioassays with juvenile rainbow trout at initial pH values from 4 to 11, kraft mill effluents were considerably less toxic at pH 9-10 than at neutrality. When pH of test solutions was controlled throughout the bioassay period, the least toxic range was 8.5-9.5. Toxicity at typical receiving-water pH values was 50-67% greater. The acute toxicity of effluent samples to yearling coho salmon was identical for these effluents in seawater and freshwater respectively, provided that the pH was adjusted and held at the same value, and that test fish were previously acclimated to the dilution water for several months. Thus seawater constituents other than pH did not affect the acute toxicity of pulp and paper mill effluents appreciably. (Deal-EIS) W79-07632

EFFECT OF UPGRADING A MUNICIPAL WASTEWATER EFFLUENT ON POLLUTION INDICATOR AND OTHER MICROORGANISMS IN RIVER WATER. Connecticut Univ., Noank. Marine Research Lab. E. A. Matson, S. G. Hornor, and J. D. Buck. Environmental Science and Technology, Vol. 13, No. 4, p 460-465, 1979. 5 fig, 6 tab, 48 ref.

Descriptors: *Coliforms, *Enteric bacteria, *Sewage bacteria, *Sewage treatment, Chlorination, Bacteria, Water quality, Water quality control, Primary treatment, Secondary treatment, Municipal wastes, Activated sludge, Waste treatment, Streptococcus, Yeasts, Biochemical oxygen demand.

Densities of total and fecal coliforms, fecal streptococci, plate count bacteria, and certain yeasts were monitored in an eastern Connecticut watershed for 1 year prior to upgrading a municipal primary settling treatment plant to activated sludge. Sampling was continued for 19 months afterward. Substantial reductions in densities of indicator and other bacteria and yeast upstream of the effluent after upgrading were associated with lower annual precipitation and reduced precipitation-associated sampling. The effluent dilution decreased from 0.84 to 1.42% of river volume due to increased daily treatment plant discharge and decreased river discharge. Calculated reductions in effluent discharge of indicators ranged from 10% (total coliforms) to 84% (fecal coliforms), while the discharge of 'total plate count bacteria' increased 500%. Chlorination procedures were still required to reduce river total coliform densities below the accepted limit. Within the microbiological perspective, upgrading this treatment plant was of limited value to potential water users. (Deal-EIS) W79-07633

EFFECTS OF VARIOUS TEMPERATURE CYCLES ON THE LARVAL DEVELOPMENT OF THE GASTROPOD MOLLUSC CREPIDULA FORNICATA. Duke Univ., Beaufort, NC. Marine Lab. J. S. Lucas, and J. D. Costlow, Jr.

Marine Biology, Vol. 51, p 111-117, 1979. 3 fig, 3 tab, 12 ref.

Descriptors: *Water temperature, *Gastropods, *Thermoperiodism, *Tissue analysis, Inhibition, Growth rates, Larval growth stage, Mollusks, Cycles, Period of growth, Biorhythms, Animal physiology, Animal metabolism, Thermal pollution.

Veligers of *Crepidula fornicata* (L.) were reared for 12 days at constant temperatures of 15, 20, 25, 30 and 35 degrees C, and at 5 degrees C daily cycles of equal periodicity (COEP) over the temperature ranges 15 to 20 degrees C, 20 to 25 degrees C, 25 to 30 degrees C and 30 to 35 degrees C. COEP consisted of equal periods (6 h) of maximum temperature, minimum temperature, and uniformly increasing and decreasing temperature each 24 h period. Survival was high and not influenced by cyclic or constant temperature from 15 to 30 degrees C. At 35 degrees C and COEP 30 to 35 degrees C, all larvae died before day 6. Shell growth rate increased markedly over the range 15 to 25 degrees C, and growth rates at cyclic temperatures in this range were intermediate between growth rates at the corresponding constant temperatures. Larvae reared at COEP 15 to 20 degrees C and COEP 30 to 35 degrees C had discontinuities in their shells due to inhibition of shell secretion during the adverse part of each temperature cycle. Groups of *C. fornicata* veligers were exposed for 2 days to daily temperature cycles of equal and unequal periodicity in their critical 30 to 35 degrees C range. These veligers showed shell growth although their body tissue declined, as indicated by decreasing carbon content per larva. Least shell growth and most body tissue loss occurred in those cycles with the longest exposure to higher temperature. Rates of shell growth of veligers in temperature cycles show an immediate effect of environmental temperature, while changes in carbon content per larva better reflect the effects of temperature on general metabolism and survival. (Deal-EIS) W79-07634

INTERACTIVE EFFECTS OF SALINITY, TEMPERATURE AND CHRONIC EXPOSURE TO OIL ON THE SURVIVAL AND DEVELOPMENTAL RATE OF EMBRYOS OF THE ESTUARINE KILLIFISH FUNDULUS HETEROCILITUS.

Texas A and M Univ., College Station. Dept. of Biology. O. Linden, J. R. Sharp, R. Laughlin, Jr., and J. M. Neff. Marine Biology, Vol. 51, p 101-109, 1979. 4 fig, 3 tab, 33 ref.

Descriptors: *Killifishes, *Toxicity, *Oil, *Salinity, *Water temperature, *Naphthalenes, *Water soluble fraction, Embryonic growth stage, Growth stages, Growth rates, Oil pollution, Mortality, Organic compounds, Aromatic compounds, Thermal stress, Salt tolerance.

The combined effect of salinity, temperature and chronic exposure to water-soluble fractions (WSF) of a No. 2 fuel oil on the survival and development rate of embryos of *Fundulus heteroclitus* are described. The embryos were exposed at 3 salinities (10, 20, 30‰ S) and 3 temperatures (20, 25, 30 degrees C) to 3 different oil concentrations (15, 20, 25% WSF, equivalent to approx 0.28, 0.38 and 0.47 ppm total naphthalenes) and to one control without oil. The results were analyzed by response-surface methodology. The lowest oil concentration was only mildly toxic to embryos under optimal salinity/temperature conditions, while the highest was extremely toxic in all factor combinations. Under optimal conditions, only the highest oil concentration resulted in more than 50% mortality. Under sub-optimal conditions, especially high and low temperatures, all 3 oil concentrations caused greater than 50% mortality. The interactive effect of salinity and temperature on survival was greatest at the lowest oil concentration. Temperature had a marked effect and salinity only a slight effect on the developmental rate of the embryos. Exposure to the low oil concentration tended to increase the temperature sensitivity of developmental duration

slightly. Generally, exposure to oil decreased the time interval between fertilization and hatching. (Deal-EIS) W79-07635

ENVIRONMENTAL DISTURBANCE AND LIFE HISTORIES: PRINCIPLES AND EXAMPLES. Saskatchewan Univ., Saskatoon. Dept. of Biology. D. M. Lehmkuhl. Journal of the Fisheries Research Board of Canada, Vol. 36, p 329-334, 1979. 2 tab, 45 ref.

Descriptors: *Environment, *Environmental effects, *Water pollution effects, *Freshwater organisms, Aquatic organisms, Benthos, Heavy metals, Nutrients, Hydrogen ion concentration, Dissolved solids, Toxicity, Water temperature, Food chain, Heavy metals, Herbicides, Pesticides, Aquatic insects, Watershed.

While many environmental disturbances have no readily detectable effect on aquatic invertebrates in the short term, they may prevent normal reproduction and cause eventual local extinction of a species. Small temperature changes may interfere with diapause signals and prevent completion of the life cycle. Heavy metals and toxic substances may drastically reduce reproduction rates in species exposed to sublethal levels. Dissolved salts and pH affect organisms at abnormally high or low levels but most mechanisms are unknown. It is concluded that relatively little information is available on the effects of environmental disturbances on life cycles. Available information, however, is sufficient to provide evidence of many problems that require attention. (Katz-EIS) W79-07636

EFFECTS OF TEMPERATURE ON THE MEDIAN TOLERANCE LIMIT OF PINK SALMON AND SHRIMP EXPOSED TO TOLUENE, NAPHTHALENE, AND COOK INLET CRUDE OIL.

National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab. S. Korn, D. A. Moles, and S. D. Rice. Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 521-525, 1979. 2 tab, 8 ref.

Descriptors: *Water temperature, *Oil spills, *Toxicity, *Pink salmon, *Shrimp, *Crude oil, *Naphthalenes, *Toluene, Oil, Oil pollution, Organic compounds, Aromatic compounds, Lethal limit, Mortality, Fish physiology, Animal physiology, Bioassay, Animal metabolism, Water pollution effects.

The concentration of toxicants in the test containers declined with time, from either evaporation losses or biodegradation, with more rapid losses occurring at higher temperatures. The 96-h TLM of pink salmon fry exposed to toluene was significantly lower at 4 degrees (6.41 ppm) than at 12 degrees C (8.09 ppm). The trend toward lower TLM's at lower temperatures was observed for the Cook Inlet crude oil WSF, but the differences were not statistically significant. The 96-h TLM for shrimp exposed to toluene and naphthalene solutions were significantly higher at 4 degrees C (toluene = 21.4 ppm, naphthalene = 2.16 ppm) than at 12 degrees (toluene = 14.7 ppm, naphthalene = 0.97 ppm). Temperature did not affect the TLM of shrimp to the Cook Inlet crude oil WSF. (Deal-EIS) W79-07637

RESIDUAL HEAVY METAL REMOVAL BY AN ALGAE-INTERMITTENT SAND FILTRATION SYSTEM.

Utah Water Research Lab., Logan. D. S. Filip, T. Peters, V. D. Adams, and E. J. Middlebrooks. Water Research, Vol. 13, p 305-313, 1979. 7 fig, 4 tab, 17 ref.

Descriptors: *Heavy metals, *Algae, *Waste water treatment, *Filtration, *Bioaccumulation, *Tissue analysis, *Oscillatoria, Chromium, Cadmium, Copper, Toxicity, Absorption, Biological treat-

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THE EFFECTS OF TOXICITY TO WATERS TO NARY REV. Woods Hole, J. M. Capuzzo. Marine Pollution, Vol. 14, ref.

Descriptors: *Chlorine, *Homarus, *Logans, Abs stress, Bioas Killifishes, salmon, Pow

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RESISTANCE TO BLOCK. Florida Univ. Engineering G. Bittin, D. Mitchell. Marine Pollution, Vol. 14, ref.

Descriptors: *radiation, *E moreceptors pounds, Ani bacteria, C Oil pollution

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ment, Phytoplankton, Chemical wastes, Growth rates, Scenedesmus, Chlorella.

A laboratory scale study was undertaken to determine the feasibility of using algae growing in wastewater lagoons to absorb residual heavy metals for subsequent complete removal by intermittent sand filtration of the metal laden algae. In semi-continuous cultures the mixed algal flora native to wastewater lagoons absorbed 70-90% of the cadmium and copper from the wastewater media. Chromium absorption was less by ratio (20% was absorbed), but the mass of chromium removed was much greater as high levels of chromium were added. Only one alga (*Oscillatoria* sp.) which was extremely resistant to chromium grew in the chromium exposed cultures. Nearly total removal of the cadmium and copper was achieved by the algae-intermittent sand filter system. The net chromium removal agreed with the accumulation analyses. The technical feasibility of removing certain heavy metals from wastewater with such a system was established. However, in depth laboratory and field studies must be conducted to maximize system efficiency, demonstrate tactical limitations, and establish design specifications. (Deal-EIS)

W79-07638

THE EFFECT OF TEMPERATURE ON THE TOXICITY OF CHLORINATED COOLING WATERS TO MARINE ANIMALS—A PRELIMINARY REVIEW,
Woods Hole Oceanographic Institution, MA.
J. M. Capuzzo.
Marine Pollution Bulletin, Vol. 10, p 45-47, 1979. 1 tab, 14 ref.

Descriptors: *Water temperature, *Toxicity, *Chlorine, *Chloramine, *Acartia, *Brachionus, *Homarus, Cooling water, Animal physiology, Halogens, Absorption, Thermal pollution, Thermal stress, Bioassay, Mortality, Oysters, Chlorination, Killifishes, Lobsters, Pink salmon, Chinook salmon, Powerplants.

The effect of temperature on the toxicity of free chlorine and chloramine to several species of marine animals is reviewed. For all species tested, except the copepod *Acartia tonsa*, temperature has a synergistic effect on the toxicity of both halogen forms. It is suggested that the effect of temperature in enhancing the toxic effects of chlorinated cooling waters to marine animals is due to an interaction of uptake rates and regulation of physiological rates and the greatest enhancement in sensitivity could be expected at the upper limit of a species' thermal tolerance. (Deal-EIS)

W79-07639

RESISTANCE OF BACTERIAL CHEMOTAXIS TO BLOCKAGE IN PETROLEUM WATERS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
G. Bitton, D. A. Chuckran, I. Chet, and R. Mitchell.
Marine Pollution Bulletin, Vol. 10, p 48-49, 1979. 4 tab, 10 ref.

Descriptors: *Pseudomonas, *Oil, *Microbial degradation, *E coli, *Kerosene, *Chemotaxis, *Chemoreceptors, Marine bacteria, Organic compounds, Animal behavior, Biodegradation, Aquatic bacteria, Coliforms, Aerobic bacteria, Oil spills, Oil pollution.

Bacterial chemotaxis is normally inhibited by hydrocarbons. In this experiment *E. coli* and *Pseudomonas* sp. were cultured in 5 different concentrations of kerosene. We have found that the chemotactic response of motile hydrocarbon degrading bacteria living in water that has been polluted with oil is unaffected by petroleum hydrocarbons. (Deal-EIS)

W79-07641

CALANOID COPEPOD EGGS IN SEABOTTOM MUDS. IV. EFFECTS OF SOME ENVIRONMENTAL FACTORS ON THE HATCHING OF RESTING EGGS,

Hiroshima Univ. (Japan). Faculty of Fisheries and Animal Husbandry.
For primary bibliographic entry see Field 5B.
W79-07642

ACUTE TOXICITY OF PLATINUM TO COHO SALMON (*ONCORHYNCHUS KISUTCH*),
Normandeau Associates, Bedford, NH.
P. F. Ferreira, Jr., and R. E. Wolke.
Marine Pollution Bulletin, Vol. 10, p 79-83, 1979. 4 fig, 1 tab, 17 ref.

Descriptors: *Toxicity, *Bioassay, *Sockeye salmon, *Platinum, *Survival, *Tissue analysis, Mortality, Fish behavior, Fry, Fish physiology, Animal metabolism, Growth rates, Animal pathology, Metals.

The effects of short-term exposure to trivalent platinum on survival, opercular movement and post-treatment growth of coho salmon fry was investigated. Employing a static water acute toxicity bioassay with platinum as ($\text{PtCl}_2\text{HCl}_2\text{H}_2$), at 8.5 + or - 0.2 degrees C, and a water hardness of 55.9 + or - 3.5 mg/L (as CaCO_3), the 24, 48, and 96-h LC50 values were 15.5, 15.2, and 2.5 mg Pt^{4+} /l respectively. Rates of opercular movement for fish exposed to platinum increased with increasing concentrations to a level of 1.0 mg/l. No further significant increases were evident above this level. Hypoactivity of fish exposed to 0.3 mg/l and higher was evident during the acute toxicity bioassay and much of the post-treatment study. Post-treatment rate of growth for fish exposed to sublethal concentration of platinum for 96 h was less than that of the controls. (Deal-EIS)

W79-07644

MODIFICATION OF THE RHEOTROPIC RESPONSE OF RAINBOW TROUT (*SALMO GAIRDNER*) BY SUBLETHAL DOSES OF THE AQUATIC HERBICIDES DIQUAT AND SIMAZINE,
Waterloo Univ. (Ontario). Dept. of Biology.
J. J. Dodson, and C. I. Mayfield.
Environmental Pollution, Vol. 18, p 147-157, 1979. 1 fig, 9 tab, 17 ref.

Descriptors: *Rainbow trout, *Pesticide toxicity, *Fish behavior, *Rheotropism, *Tissue analysis, *Bioaccumulation, *Simazine, Herbicides, Diquat, Absorption, Bioassay, Fish physiology, Currents (Water), Chemical analysis, Pesticide residues, Pesticide kinetics, Path of pollutants.

The rheotaxis and swimming speeds of rainbow trout in response to a water current simulated by moving a striped background past the fish were observed following 24-h exposures to field application concentrations of the herbicides diquat, simazine and their commercial formulations. Fish tissues were subsequently analysed to assess the extent of uptake of the herbicides. Toxicological modification of rheotaxis and swimming speeds was observed in fish exposed to diquat and its formulation Reglone AR resulting in an increased incidence of downstream drift. Simazine residues in fish increased in proportion to treatment levels whereas diquat residues in fish levelled off with increasing treatment levels. The toxicological modification of rheotropism is presented as a sensitive bioassay to assess sublethal effects of biocides. (Deal-EIS)

W79-07645

UPTAKE AND LOSS OF ZINC AND LEAD BY MUSSELS (*MYTILUS EDULIS*) AND RELATIONSHIPS WITH BODY WEIGHT AND REPRODUCTIVE CYCLE,
Australian Atomic Energy Commission Research Establishment, Lucas Heights. Environmental Biology Section.
R. D. Simpson.
Marine Pollution Bulletin, Vol. 10, p 74-78, 1979. 4 fig, 3 tab, 21 ref.

Descriptors: *Zinc, *Lead, *Mussels, *Absorption, *Tissue analysis, *Bioaccumulation, *Mytilus, Chemical analysis, Animal physiology, Size, Animal metabolism, Heavy metals, Biorhythms, Reproduction, Growth stages, Cycles, England.

The uptake and loss of zinc and lead from the whole soft parts of the mussel *Mytilus edulis* were investigated under natural conditions in north-east England. Mussels in which high concentrations of these metals were found were transferred to an area where low concentrations were found, and vice versa. Mussels from both areas were also kept in tanks and periodic measurements of metal contents were made. Indications of uptake and loss were greatly affected by changing body weights and the work suggests that phase of reproductive cycle (for animals in the environment) and condition (for animals in tanks) have to be closely considered when reporting on levels of metals in mussels, especially in terms of concentration. (Deal-EIS)

W79-07646

SOME EFFECTS OF SUB-LETHAL CONCENTRATIONS OF COPPER ON A MARINE COPEPOD,
Athens Univ. (Greece). Zoological Lab. and Museum.
M. Moraitou-Apostolopoulou, and G. Verriopoulos.
Marine Pollution Bulletin, Vol. 10, p 88-92, 1979. 3 fig, 1 tab, 31 ref.

Descriptors: *Copper, *Toxicity, *Copepods, *Acartia, Animal behavior, Animal physiology, Animal metabolism, Fecundity, Food habits, Feeding rates, Respiration, Oxygen requirements, Adaptation, Plankton, Heavy metals, Mortality.

Laboratory experiments were carried out to determine the influence of different concentrations of copper in feeding and respiratory rates, fecundity and longevity of the marine planktonic copepod *Acartia clausi*, taken from a polluted and a clean area of the Saronic gulf (Greece). In the range of copper concentrations 0.001 to 0.01 mg l⁻¹, all tested activities of the animals coming from the clean region seemed affected. Feeding activity, longevity and fecundity showed a progressive reduction from 0.001 to 0.001 to 0.01 mg l⁻¹. The pollution-adapted population of *Acartia* seemed more resistant to sub-lethal copper stress. Longevity and respiration were affected in all concentrations used. The fecundity of the pollution-adapted population was higher than that of the clean area, showing a slight increase at 0.001 and 0.0025 mg l⁻¹ dropping to the control animals fecundity level at 0.01 mg l⁻¹. (Deal-EIS)

W79-07647

STRONTIUM, CALCIUM AND MAGNESIUM CONTENTS OF SOME MARINE ALGAE FROM THE WEST COAST OF INDIA,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
S. S. Gogate, S. M. Shah, and C. K. Unni.
Journal of the Marine Biological Association of India, Vol. 17, No. 1, p 28-33, 1975. 3 tab, 20 ref.

Descriptors: *Absorption, *Marine algae, *Strontium, *Calcium, *Magnesium, *Bioaccumulation, *Tissue analysis, *India, Phaeophyta, Chlorophyta, Rhodophyta, Chemical analysis, Radioisotopes, Metabolism.

As part of programme of work on marine radioactivity in the aquatic environment a few samples of algae were collected from the west coast of India and analysed for strontium, calcium and magnesium contents. Strontium to calcium atom ratio in brown algae was found to vary from .0216 to .0295 while in green and red algae it varied from .0051 to .0091 and .0049 to .0056 respectively. Brown algae accumulated strontium in preference to calcium from sea water. All species were shown to concentrate strontium, calcium and magnesium to some extent. (Deal-EIS)

W79-07648

THE EFFECT OF TEMPERATURE ON GROWTH, PHYSIOLOGY, AND GAMETOGENESIS IN THE MANILA CLAM TAPES PHILIPPINARUM (ADAMS & REEVE, 1850),
Woods Hole Oceanographic Institution, MA.
R. Mann.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

Journal of Experimental Marine Biology and Ecology, Vol. 38, p 121-133, 1979. 1 fig, 4 tab, 22 ref.

Descriptors: *Clams, *Water temperature, *Tissue analysis, *Histology, *Gametogenesis, Ammonia, Animal metabolism, Animal physiology, Biochemistry, Reproduction, Growth rates, Carbohydrates, Mollusks, Water pollution effects.

Populations of the Manila clam were maintained at temperatures of 12, 15, 18, and 21 degrees C for a period of 19 weeks. Regular determinations were made of ammonia excretion rate following which animals were sacrificed for estimation of dry meat weight, dry shell weight, biochemical composition, and gonadal development. T. philippinarum increased from an initial dry meat weight of 291.5 mg to final values of 957.9, 733.0, 735.0, and 586.0 mg at 12, 15, 18, and 21 degrees C, respectively. An initial increase in percentage carbohydrate content was evident at all temperatures. This was followed by carbohydrate depletion associated with gametogenesis, the transition from accumulation to depletion occurring earlier with increasing temperature. Ripe gonadal material was evident at all temperatures, but spawning was only evident at 15, 18, and 21 degrees C. Ammonia excretion at 12, 15, and 18 degrees C showed an allometric relationship to meat weight; this was not so at 21 degrees C. (Deal-EIS)

W79-07650

BACTERIAL STREAMER GROWTH IN A DISUSED PYRITE MINE,
University Coll. of North Wales, Bangor. Dept. of Biochemistry and Soil Science.
D. B. Johnson, W. I. Kelso, and D. A. Jenkins.
Environmental Pollution, Vol. 18, p 107-118, 1979. 5 fig, 3 tab, 22 ref.

Descriptors: *Acid mine water, *Acid streams, *Thiobacillus ferrooxidans, Acidic water, Mine drainage, Mine wastes, Pyrite, Iron, Sulfates, Hydrogen ion concentration, Bacteria, Acid bacteria, Sulfur bacteria, Water chemistry, Chemical analysis, Seasonal.

A disused pyrite mine in the Conwy Valley, North Wales, was found to contain copious amounts of 'acid streamer' of heterotrophic bacterial origin. The geology of the mine is discussed and analytical data on the acid stream which flows through the mine are presented. The UV and visible spectra of the typically orange/red-coloured water were investigated and the main ionic species responsible for the colour identified as being $\text{Fe}(\text{OH})_2^+$, $\text{Fe}(\text{SO}_4)_2^-$, $\text{Fe}(\text{SO}_4)^+$. The local pollution caused by the acid discharge is mentioned. (Deal-EIS)

W79-07651

ADAPTATIONS TO SULFIDE IN THE MEIOFAUNA OF THE SULFIDE SYSTEM. I. 3SS-SULFIDE ACCUMULATION AND THE PRESENCE OF A SULFIDE DETOXIFICATION SYSTEM,
North Carolina, Univ. at Chapel Hill. Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W79-07652

MERCURY ACCUMULATION IN IPOMOEA AQUATICA (FORSK) NEAR A CAUSTIC SODA FACTORY IN THAILAND,
Helsinki Univ. (Finland). Dept. of Environmental Science.
S. Suckcharoen.
Water, Air and Soil Pollution, Vol. 10, p 451-455, 1979. 2 fig, 19 ref.

Descriptors: *Mercury, *Industrial wastes, *Food chains, *Bioaccumulation, *Tissue analysis, *Thailand, *Ipomoea, Path of pollutants, Heavy metals, Chemical wastes, Plant physiology, Public health, Human pathology, Chemical analysis, Water quality standards.

Ipomoea aquatica is commonly used as a vegetable and pig food in Thailand. The present study shows that the leaves and floating stems of this plant

collected near a caustic soda factory in Thailand had accumulated between 0.75 to 1.26 ppm (average 0.95 ppm) Hg in the leaves and 0.28 to 0.68 ppm (average 0.43 ppm) Hg in the floating stems. Leaves and floating stems from unpolluted areas had Hg contents between 0.1 to 0.17 ppm and 0.01 to 0.06 ppm, respectively. The contaminated *I. aquatica* in the study area represents an additional source of Hg, since fish from the same area are also polluted with Hg. This constitutes a serious risk to public health. (Deal-EIS)

W79-07653

TOXICITY OF PERMETHRIN, DECAMETHRIN, AND RELATED PYRETHROIDS TO SALMON AND LOBSTER,
Fisheries and Marine Service, St. Andrews (New Brunswick). Biological Station.
V. Zitko, D. W. McLeese, C. D. Metcalfe, and W. G. Carson.
Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 338-343, 1979. 3 tab, 8 ref.

Descriptors: *Insecticides, *Pesticide toxicity, *Lobsters, *Atlantic salmon, *Pyrethroids, *Permethrin, *Decamethrin, Toxicity, Mortality, Chemical properties, Bioassay, Juvenile growth state, Chemical analysis, Lethal limit, Gas chromatography.

The lethality of permethrin, its IR-cis-isomer, decamethrin, and its dichloro analogue to juvenile Atlantic salmon (*Salmo salar*) and adult lobster (*Homarus americanus*) were determined. As expected from the insecticidal activity patterns, IR-cis permethrin is more lethal than permethrin to both salmon and lobsters. The lethality of the cyano-substituted pyrethroids are higher than one would expect from the lethality-octanol/water partition coefficient relationship, derived previously. (Deal-EIS)

W79-07654

ALKANES IN PLANKTON FROM THE BUC-CANEER OILFIELD,
Houston Univ., TX. Dept. of Biophysical Sciences.
B. S. Middlefield, E. S. Chang, and B. Basile.
Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 421-427, 1979. 3 tab, 13 ref.

Descriptors: *Oil, *Oil pollution, *Zooplankton, *Biogenic hydrocarbons, *Alkanes, *Tissue analysis, Offshore platforms, Brines, Metabolism, Organic compounds, Oil spills, Gas chromatography, Chemical analysis, Path of pollutants.

Samples of zooplankton were examined to determine whether they contain petroleum alkanes and whether they might contribute significantly to the dispersion of oil discharged from the production platforms. The total alkane concentrations ranged from 250 ppb to 3.58 ppm. There was also a wide variation in the distribution of alkanes from sample to sample, reflecting species differences. In general, the samples from the center of the oilfield were contaminated with petroleum alkanes while those samples collected at distances from the oilfield predominantly contained biogenic alkanes. (Deal-EIS)

W79-07655

MERCURY POLLUTION OF MEDITERRANEAN SEDIMENTS AROUND ALEXANDRIA, EGYPT,
Alexandria Univ. (Egypt). Faculty of Science.
M. K. El-Sayed, Y. Halim, H. M. Abdel-Kader, and M. H. Moeness.
Marine Pollution Bulletin, Vol. 10, p 84-86, 1979. 1 fig, 3 tab, 11 ref.

Descriptors: *Mercury, *Industrial wastes, *Bottom sediments, *Egypt, Chemical wastes, Path of pollutants, Heavy metals, Sediments, Beaches, Sands, Sewage effluent, Water pollution sources, Chemical analysis, Spectrophotometry, Chlor-alkali plants.

Elemental mercury is associated with industrial wastes discharged through the main effluent pipe of the Chlorine-Alkali plant at El-Max area west of

Alexandria. The minimal mercury value of 0.1 ppm dry weight is assumed to be the background level for uncontaminated sediments in the area. Mercury levels ranged from 8.02 to 15.5 ppm in the beach sands from the polluted area beyond the plant, and from 0.14 to 1.4 ppm in the bottom sediments off Alexandria. The Chlorine-Alkali plant is obviously the major source of mercury pollution. The contribution of land drainage, agricultural and domestic wastes is insignificant. (Deal-EIS)

W79-07656

ZINC AND COPPER LEVELS IN BELFAST LOUGH,
Northern Ireland Polytechnic Jordanstown. School of Life Sciences.
M. S. McGrath, and J. Austin.
Marine Pollution Bulletin, Vol. 10, p 86-88, 1979. 1 fig, 2 tab, 6 ref.

Descriptors: *Zinc, *Copper, *Biochemical oxygen demand, *Dissolved oxygen, *Irish Sea, *Belfast Lough (Ireland), Heavy metals, Municipal wastes, Industrial wastes, Water quality, Water chemistry, Chemical analysis, Spectrophotometry, Waste disposal.

A survey of dissolved zinc, copper, oxygen and biochemical oxygen demand in Belfast Lough has been carried out. Zinc and to a lesser extent copper occur at elevated levels compared with a non-industrialized area of the Irish Sea. Zinc levels are particularly high in the marginal waters of the north shore of the lough. Dissolved oxygen and biochemical oxygen demand levels indicate that pollution of the lough by oxygen-demanding wastes is not a serious problem. (Deal-EIS)

W79-07657

APPLICATION OF A NEW BIOASSAY TO SCREEN THE TOXICITY OF POLYCHLORINATED BIPHENYLS ON BLUE-GREEN ALGAE,
Institute fuer Wasserforschung G.m.b.H., Dortmund, (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W79-07658

STUDIES ON THE TOXICITY OF PULP AND PAPER FACTORY WASTES TO THE FISH NOTOPTERUS NOTOPTERUS (PALLAS),
D.A.V. Coll., Muzaffarnagar (India). Pollution-Relevant Research Lab.
S. R. Verma, G. R. Shukla, and R. C. Dalela.
Acta Hydrochimica et Hydrobiologica, Vol. 6, p 541-552, 1978. 8 tab, 23 ref.

Descriptors: *Bioassay, *Pulp wastes, *Toxicity, *Notopterus, Pulp and paper industry, Industrial wastes, Chemical wastes, Water temperature, Hydrogen ion concentration, Dissolved oxygen, Fish physiology, Chemical analysis, Water chemistry, Mortality, Fish behavior.

Studies are performed on the toxicity for 24, 48, 72 and 96 hours in the static test with dilutions of wastewaters from pulp and paper production as well as of the mixed wastewater. The pulp waste shows the highest toxic effect. A general increase of the toxic effect is caused by a rise in temperature from 26 degrees C to 36 degrees C and an increase of the pH value from 7.5 to 8.2. The increase of the oxygen concentration from 5.2 to 7.2 mg/l results in a reduction of the toxicity of the pulp and mixed wastes, the size of fishes having a significant effect only for the pulp waste. (Deal-EIS)

W79-07659

DOMINANCE AND DISTRIBUTION OF BENTHIC MACROPHYTE ASSEMBLAGES IN A NORTH FLORIDA ESTUARY (APALACHEE BAY, FLORIDA),
Florida State Univ., Tallahassee. Dept. of Biological Science.
M. S. Zimmerman, and R. J. Livingston.
Bulletin of Marine Science, Vol. 29, No. 1, p 27-40, 1979. 3 fig, 4 tab, 13 ref.

Descriptors: *Phytolacca*, *Toxicity, Florida, Wastes, Chemical wastes, Rhodophyta, Fests, Biomass Bay.

A comparative distribution of shallow portulaca. This inc by bleached holloway River (minated com system). Met phytes were tive dominat luted areas. have extreme semblages of the species portions of the levels of BK ntly reduce control stati removal of creased levee cruitment of chronic imp patterns of to published aquatic syste W79-07660

PHYTOPLANKTON IN THE ACIDIFIED LAKE
1977,
Ontario Ministry of the Environment, N. D. Yan, Water, Air, 55, 1979. 4 fig

Descriptors: *Lakes, *Phytoplankton, *Toxicity, *Concentration, Spectrophotometry, Cyanophyta

Phytoplankton water Lake ed lake near dinium conc 55% of the to 0.73 mg lakes if it biomass. Th three other lakes in On of all conc inconspicuo uncontamin better conc than with some evide with the h itations of p surveys are W79-07661

COMPARISON OF THE TOXICITY OF POLYCHLORINATED BIPHENYLS TO THE PULP AND PAPER INDUSTRY
Tulane Univ. S. W. Fing Bulletin of Toxicology

Descriptor: *Toxicity, Bioassay, Growth rate, Chlorophyll, Water pollution

The objective of the study was to determine the

Effects Of Pollution—Group 5C

Descriptors: *Pulp wastes, *Biological communities, *Toxicity, *Algae, *Diversity, *Species diversity, Florida, Pulp and paper industry, Industrial wastes, Chemical wastes, Aquatic populations, Rhodophyta, Benthic flora, Water pollution effects, Biomass, Dominant organisms, Apalachee Bay.

A comparative analysis was made concerning the distribution of benthic macrophyte assemblages in shallow portions of Apalachee Bay (north Florida). This included a comparison of areas affected by bleached kraft mill effluents (BKME) (the Fenholloway River system) with appropriate uncontaminated control stations (the Econfinia River system). Meter-square samples of benthic macrophytes were collected monthly in both areas. Relative dominance was generally higher in the unpolluted areas. Areas of acute effect were found to have extremely low biomass and characteristic assemblages of various macrophyte species. Most of the species in unpolluted areas were present in portions of the bay characterized by chronic (low) levels of BKME. However, biomass was consistently reduced in such areas when compared to control stations. It was postulated that selective removal of dominant species by BKME (e.g., increased levels of color and turbidity) allowed recruitment of various 'rare' species in areas of chronic impact, thus contributing to anomalous patterns of community structure when compared to published data from other pollution-stressed aquatic systems. (Deal-EIS) W79-07660

PHYTOPLANKTON COMMUNITY OF AN ACIDIFIED, HEAVY METAL-CONTAMINATED LAKE NEAR SUDBURY, ONTARIO: 1973-1977.
Ontario Ministry of the Environment, Rexdale. Limnology and Toxicity Section.
N. D. Yan.
Water, Air and Soil Pollution, Vol. 11, No. 1, p 43-55, 1979. 4 fig, 3 tab, 32 ref.

Descriptors: *Phytoplankton, *Heavy metals, *Lakes, *Peridinium, Acidic water, Biomass, Biological communities, Phosphorus, Hydrogen ion concentration, Water chemistry, Canada, Seasonal, Spectrophotometry, Chlorophyta, Chrysophyta, Cyanophyta, Sudbury, Ontario.

Phytoplankton data for 1973 to 1977 from Clearwater Lake, an acid- and heavy metal-contaminated lake near Sudbury, Ontario are presented. Peridinium inconspicuum comprised between 30 and 55% of the average, ice-free period biomass of 0.33 to 0.73 mg/l and is considered indicative of acidic lakes if it forms a substantial portion of the total biomass. The data were compared with those from three other contaminated and ten uncontaminated lakes in Ontario. The phytoplankton communities of all contaminated lakes were dominated by P. inconspicuum while chrysophytes dominated the uncontaminated lakes. Community biomass was better correlated with phosphorus concentration than with hydrogen ion concentration. There was some evidence of reductions of biomass in lakes with the highest heavy metal concentrations. Limitations of phytoplankton data collected in synoptic surveys are discussed. (Deal-EIS) W79-07661

COMPARISON OF THE EFFECTS OF FOURTEEN-DAY AND CHRONIC EXPOSURES TO A POLYCHLORINATED BIPHENYL, AROCLOR 1242, ON MOLTING OF THE FIDDLER CRAB, UCA PUGILATOR.
Tulane Univ., New Orleans, LA. Dept. of Biology.
S. W. Fingerman, and M. Fingerman.
Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 352-357, 1979. 2 fig, 14 ref.

Descriptors: *Polychlorinated biphenyls, *Crabs, *Toxicity, *Aroclors, *Molting, *Ecdysis, *Uca, Bioassay, Laboratory tests, Growth stages, Growth rates, Animal metabolism, Pesticide toxicity, Chlorinated hydrocarbon pesticides, Inhibition, Water pollution effects.

The object of the present experiments was to determine whether the inhibitory effect of Aroclor

1242 on molting of the fiddler crab can be at least partially reversed by returning the crabs to sea water that did not contain this pollutant after they had been exposed to it for 14 days. It was discovered that crabs removed from the effect of Aroclor-1242 underwent ecdysis at a faster rate (7%) than those kept continuously in PCB-contaminated water, but still at a much slower rate than the control group. It appears that once the crabs had been exposed for 14 days they accumulated enough PCB to have a long-lasting inhibitory effect on molting. (Deal-EIS) W79-07662

THE INFLUENCE OF REARING DENSITY ON THE SUBSEQUENT RESPONSE TO DDT DOSING FOR TADPOLES OF THE FROG RANA TEMPORARIA.
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
A. S. Cooke.

Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 837-841, 1979. 2 tab, 10 ref.

Descriptors: *DDT, *Frogs, *Pesticide toxicity, *Tadpoles, *Tissue analysis, *Bioaccumulation, *Rana, Growth stages, Growth rates, Animal populations, Density, Chlorinated hydrocarbon pesticides, Pesticide kinetics, Path of pollutants, Pesticide residues, Animal behavior, Animal physiology.

By rearing at two densities that differed five-fold, tadpoles were produced that differed in weight, by a factor of about two-fold. When treated with DDT (0.1ppm), the large tadpoles showed no poisoning symptoms under conditions that caused appreciable sublethal effects amongst the small tadpoles. Relative to tadpoles in the field or in stock captive cultures, neither the small nor the large tadpoles were particularly unusual as regards size, although both tended towards the extremes of the normal size range. In addition, the small tadpoles accumulated higher body burdens of DDT. (Deal-EIS) W79-07663

OXYGEN CONSUMPTION IN LEPOMIS MACROCHIRUS EXPOSED TO 2,4-D OR 2,4,5-T.
Clemson Univ., SC. Dept. of Zoology.
C. Sigmon.
Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 826-830, 1979. 2 tab, 11 ref.

Descriptors: *2,4-D, *2,4,5-T, *Pesticide toxicity, *Sunfishes, *Tissue analysis, Water pollution effects, Lepomis, Bluegill sunfish, Respiration, Oxygen requirements, Herbicides, Chlorinated hydrocarbon pesticides, Water temperature, Chemical analysis, Fish physiology, Absorption.

Respiratory changes and herbicide uptake by Lepomis macrochirus were analyzed following short-term exposure to 3 ppm of 2,4-D or 2,4,5-T at three water temperatures (20, 25, 30 degrees C). While weight and temperature were found to be significant variables in determining respiration, exposure to the herbicides was not. Herbicide uptake was quite small. More 2,4,5-T than 2,4-D was retained by the fish. Since 2,4-D is more rapidly degraded by microorganisms, less would be available for uptake. (Deal-EIS) W79-07664

THE EFFECTS OF AN EXPERIMENTAL SPILLAGE OF OIL SANDS TAILINGS SLUDGE ON BENTHIC INVERTEBRATES.
Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.
D. R. Barton, and R. R. Wallace.
Environmental Pollution, Vol. 18, p 305-312, 1979. 4 tab, 15 ref.

Descriptors: *Oil spills, *Toxicity, *Benthic fauna, *Crude oil, Oil pollution, Oil, Organic compounds, Canada, Bioindicators, Sediments, Bottom sediments, On-site investigations, Heavy metals, Sands, Alberta, Benthos, Aquatic insects.

A very minor, instantaneous spillage of oil sands tailings sludge was introduced experimentally to a small part of a river in northern Alberta, Canada. A 60% reduction in the standing stock of benthic invertebrates occurred throughout a four-week period in the immediate area of the spillage. Sensitive indicator organisms decreased in abundance over an area of at least 30 m downstream of the spillage. The tailings sludge contained fine silt, heavy, sticky oils and heavy metals, all of which would have a deleterious effect on stream benthos. The fine silt mixed with the sticky oils of the sludge probably constituted the principal hazard to aquatic communities. It is recommended that appropriate measures should be established so as to prevent the addition of oil sands tailings sludge, by either accident or design, to lakes or rivers. (Deal-EIS) W79-07665

OXYGEN CONSUMPTION IN DAPHNIA PULEX EXPOSED TO 2,4-D OR 2,4,5-T.
Clemson Univ., SC. Dept. of Zoology.
C. Sigmon.
Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 822-825, 1979. 2 tab, 6 ref.

Descriptors: *Pesticide toxicity, *Daphnia, *Oxygen requirements, *2,4-D, *2,4,5-T, Oxygen, Chlorinated hydrocarbon pesticides, Herbicides, Toxicity, Water temperature, Chemical analysis, Respiration, Animal physiology, Water pollution effects.

Oxygen consumption by Daphnia pulex was measured for 9 hours following exposure to two concentrations (1,3ppm) of 2,4-D or 2,4,5-T at three water temperatures (20, 25, 30 degrees C). A general trend of increased respiration at 30 degrees C was apparent in both the 2,4-D and 2,4,5-T experiments, although the differences achieved statistical significance only in the 2,4,5-T data. The physiological basis for the effect of these herbicides on respiration is not known. (Deal-EIS) W79-07666

ORGANOCHLORINE INSECTICIDE RESIDUES IN AMPHIBIANS AND REPTILES FROM IOWA AND LIZARDS FROM THE SOUTHWESTERN UNITED STATES.
Iowa State Univ., Ames. Dept. of Entomology.
F. Punzo, J. Laveglia, D. Lohr, and P. A. Dahm.
Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 842-848, 1979. 2 tab, 8 ref.

Descriptors: *Pesticide residues, *Reptiles, *Amphibians, *Tissue analysis, *Lizards, Chlorinated hydrocarbon pesticides, Chemical analysis, Pesticide kinetics, Iowa, Southwest U.S., DDT, Dieldrin, DDE, Toads, Heptachlor, Frogs, Food chains, Snakes.

Ecosystems are generally contaminated with low levels of organochlorine insecticide residues. Numerous reports of residues in biota include relatively little data for amphibians and reptiles. To help fill this void, specimens of amphibians and reptiles were collected from 2 agricultural areas of Iowa, and lizards were collected from nonagricultural areas in Arizona, New Mexico, and Texas. Iowa specimens came from a region with past use of organochlorine insecticides, particularly DDT as a general purpose insecticide and aldrin and heptachlor for control of soil-insect pests. Only residues of DDE and dieldrin in viscera of toads and of DDE, dieldrin, heptachlor epoxide in fat and eggs from reptiles were found in specimens collected in Iowa. Low or nondetectable residues of DDE and dieldrin were found in carcass and viscera samples from lizards collected in the southwestern United States. (Deal-EIS) W79-07667

EMBRYOTOXICITY AND HATCHABILITY IN CICHLASOMA NIGROFASCIATUM (GUENTHER) EGGS AND LARVAE BRIEFLY EXPOSED TO LOW CONCENTRATIONS OF ZINC AND COPPER IONS.
Uppsala Univ. (Sweden). Inst. of Zoology.
P. T. E. Ozoh, and C.-O. Jacobson.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 782-786, 1979. 2 tab, 11 ref.

Descriptors: *Zinc, *Copper, *Toxicity, *Cichlids, *Zebrafish, *Mutagens, Fresh water fish, Fish eggs, Larval growth stage, Embryonic growth stage, Hatching, *Metals, Fish physiology, Ions, Mortality, Bioassay.

Zebra cichlid eggs were exposed to 0, 16 and 32 ppb of zinc and copper singly and in combination. The presence of copper ions affected both eggs and larvae. The pro-larvae and larvae exposed to copper ions for 48 h showed many morphological malformations, especially in the nervous system. Zinc ions caused no observable malformations in eggs or larvae. In terms of hatchability, zinc had a more severe effect. This was to copper's bactericidal effect at low concentrations, which facilitated hatching. For the two factor interactions of zinc and copper, concentrations of 32 ppb zinc and 16 ppb produced the lowest hatching success. (Deal-EIS)

W79-07668

INDUCTION OF BENZO (A) PYRENE MONOOXYGENASE IN FISH AND THE SALMONELLA TEST AS A TOOL FOR DETECTING MUTAGENIC/CARCINOGENIC XENOBIOTICS IN THE AQUATIC ENVIRONMENT.
Institut Rudjer Boskovic, Zagreb (Yugoslavia).
Lab. for Marine Molecular Biology.
B. Kurelec, Z. Motajarsic, M. Rijavec, M. Alaceric, and S. Brivic.

Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 799-807, 1979. 1 fig, 1 tab, 23 ref.

Descriptors: *Toxicity, *Carp, *Enzymes, *Salmonella, *Mullets, *Mutagens, *Carcinogens, *Tissue analysis, *Crude oil, *Hexane, *Aflatoxin, Chemical analysis, Organic compounds, Fish physiology, Sea water, Path of pollutants.

Considering the induction of Benzopyrene Monooxygenase as a means of detoxification in fish, we studied the consequences of i/p application of polluted water extracts from different marine sites to young carp. Aliquots of these extracts served in Salmonella/microsome mutagenicity tests using liver homogenates of pollution-induced fish as activating systems. The pollutants tested were hexane, commercial corn oil, aflatoxin, NADP, NADPH, glucose-6-phosphate, dimethyl sulphoxide, and benzo(a)pyrene. A single i/p injection of 25 or 50 µg benzo(a)pyrene, 25 µg aflatoxin, 50 µl crude oil and hexane extract of seawater was sufficient to induce BPO activity in carp within one or two days. The ability of the compounds to induce mutations in Salmonella typhimurium was influenced by the presence of liver postmitochondrial fraction. (Deal-EIS)

W79-07669

SCHEMA OF LETHAL ACTION OF COPPER ON MUSSELS.
Centre Oceanologique de Bretagne, Brest (France).

J. L. M. Martin.

Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 808-814, 1979. 3 fig, 1 tab, 14 ref.

Descriptors: *Copper, *Toxicity, *Mussels, *Bioaccumulation, *Tissue analysis, *Mytilus, Bioassay, Chemical analysis, Path of pollutants, Chemical reactions, Lethal limit, Bioassay, Animal physiology, Animal metabolism, Metals, Spectrophotometry, Chemical properties, Mode of action.

In order to demonstrate the relationships between concentration, lethal time and bioaccumulation levels and rates in determining the response of an organism to a toxic element, experiments were carried out on Mytilus edulis using copper as the test element. The results show that the toxicity of copper to mussels is regulated by a two step reaction. The first factor is the speed of accumulation in the test organism while the second determining factor is the speed of action of the test element in producing toxic effects at the target organ(s). (Deal-EIS)

W79-07670

ACUTE TOXICITY OF DECHLORINATED DDT, CHLORDANE AND LINDANE TO BLUEGILL (LEPOMIS MACROCHIRUS) AND DAPHNIA MAGNA.

Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.

W. F. Randall, W. H. Dennis, and M. C. Warner.
Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 849-854, 1979. 2 tab, 9 ref.

Descriptors: *DDT, *Pesticide toxicity, *Daphnia, *Sunfishes, *Catalysts, *Chlordane, *Lindane, *Dechlorination, Zooplankton, Fresh water fish, Chlorinated hydrocarbon pesticides, Chemical analysis, Chemical reactions, Catalysts, Nickel, Chemical wastes, Waste disposal, Insecticides, Bioassay, Waste treatment.

The purpose was to test the effectiveness of Ni2B-catalyzed dechlorination in reducing the acute toxicity of DDT, chlordane and lindane to bluegill and daphnia. It was discovered that the acute toxicity of DDT and chlordane formulations was considerably reduced by nickel boride-catalyzed dechlorination. However, the reduction in toxicity was not sufficient to warrant the use of this method for the ultimate disposal of these pesticides. The dechlorination of lindane by this method appears to have potential as a chemical disposal procedure. (Deal-EIS)

W79-07671

THE REPRODUCTIVE BEHAVIOR OF GAMMARUS DUEBENI (LILLJEBORG), AND THE INHIBITORY EFFECT OF A SURFACE ACTIVE AGENT.

Southampton Univ. (England). Dept. of Oceanography.

M. C. Lyes.

Marine Behavior and Physiology, Vol. 6, p 47-55, 1979. 5 fig, 16 ref.

Descriptors: *Animal behavior, *Reproduction, *Surfactants, *Toxicity, *Gammarus, *Chemoreceptors, *TWEEN 80, *Pheromones, Bioassay, Inhibition, Bioassay, Crustaceans, Chemical analysis, Animal physiology, Amphipoda.

The process by which reproductive behavior in the male Gammarus duebeni is evoked has been found to depend upon the reception of a chemical cue from the female. This cue is perceived by receptors on the second antennae and its function is to synchronize mating with the suitable phase of ecdysis in the female. Small concentrations of the surfactant TWEEN80 are shown to interfere with the reception of this chemical cue, resulting in a decrease in mating success. (Deal-EIS)

W79-07672

CHEMOSENSORY INDUCED BRADYCARDIA IN THE KELP CRAB, PUGETTIA PRODUCTA (RANDALL).

California Univ., Santa Barbara. Dept. of Biological Sciences.

R. K. Zimmer, D. P. Cook, and J. F. Case.

Journal of Experimental Marine Biology and Ecology, Vol. 38, p 135-150, 1979. 5 fig, 5 tab, 31 ref.

Descriptors: *Animal physiology, *Crabs, *Inhibition, *Carbohydrates, *Chemoreceptors, *Water soluble fraction, Animal metabolism, Chemical analysis, Amino acids, Oil, Toxicity, Organic compounds, Crustaceans, Chemical properties.

Bradycardia was induced in specimens of Pugettia producta by chemical stimulation of the branchial chamber with synthetic clam extract. Chemical stimulation of the dactyls, antennules, and mouthparts did not effect cardiac inhibition. Stimulation of the branchial chamber with amino acids and sugars evoked cardiac inhibition that was significantly greater than that induced by sea-water controls. Of the sugars tested, disaccharides were generally found to have a greater capacity to induce bradycardia than monosaccharides. The possibility of a disaccharide or polysaccharide receptor is discussed. Taurine and B-alanine induced brady-

cardia was significantly greater than that effected by other amino acids. All tested amino acids were, however, at least mildly effective ($P < 0.10$); thus it appears that several types of amino-acid receptors are likely to exist. From these results and from observations described by other investigators, it is apparent that the branchial chamber is a major chemoreceptive site in decapod crustaceans. (Deal-EIS)

W79-07673

IN VIVO EFFECT ON ATPASE IN CERTAIN TISSUES OF LABEO ROHITA AND SACCOBRANCHUS FOSSILIS, FOLLOWING CHRONIC CHLORDANE INTOXICATION.
D. A. V. Coll, Muzaffarnagar (India). Pollution Relevant Research Lab.

S. R. Verma, S. K. Bansal, A. K. Gupta, and R. C. Dalela.

Bulletin of Environmental Contamination and Toxicology, Vol. 20, p 769-777, 1978. 2 tab, 18 ref.

Descriptors: *Pesticide toxicity, *Enzymes, *Tissue analysis, *Chlordane, *Labeo, *Saccobranchus, Chlorinated hydrocarbon pesticides, Biochemistry, Fish physiology, Chemical analysis, Sodium, Potassium, Magnesium, Freshwater fish.

The purpose of this study was to determine the effect of various concentrations of chlordane upon the ATPase system in the brain, gill, liver and kidney or two fresh water teleosts, Labeo rohita and Saccobranchus fossilis, following chronic chlordane intoxication after 30 and 60 days treatment. Mg++, Na+ and K+ ATPases were analyzed. The present investigation observed inhibition of all the three ATPases in both fish Labeo rohita and Saccobranchus fossilis in all tissues, following chronic chlordane treatment. However, inhibition of ATPases in all the tissues of Labeo rohita was found higher as compared to Saccobranchus fossilis, indicating more susceptibility of the former to chlordane. (Deal-EIS)

W79-07674

DISTRIBUTION OF CHAETOGNATHS ALONG THE SALINITY GRADIENT IN THE COCHIN BACKWATER, AN ESTUARY CONNECTED TO THE ARABIAN SEA.

National Inst. of Oceanography, Cochin (India); and Indian Ocean Biological Centre.

V. R. Nair.

Journal of the Marine Biological Association of India, Vol. 16, No. 3, p 721-730, 1974. 5 fig, 1 tab, 15 ref.

Descriptors: *Fish populations, *Salinity, *Chaetognaths, Temporal distribution, Diel migration, Spatial distribution, Seasonal, Monsoons, Estuaries, Growth stages, Fish behavior, Fish migration, Diurnal distribution, Arabian Sea, India.

A study was made of the chaetognaths of the Cochin Backwater. Krohnitta pacifica Aida, Sagitta bedoti Beraneck, Sagitta enflata Grassi and S. oceanica Gray were the species found in the collections. S. bedoti was the dominant chaetognath. S. oceanica is recorded for the first time from Indian waters. Salinity plays a major part in controlling the distribution of chaetognaths in this estuary. They penetrated to the southernmost part of the estuary during the premonsoon period when a uniform high salinity prevailed throughout the system. In the postmonsoon period the chaetognath population synchronically followed the steep gradient in salinity along the estuary and became restricted to its seaward end. It is suggested that during the monsoon period they are removed from the area and fresh recruits from the sea are brought back to the system along with the incoming waters of the postmonsoon periods. (Deal-EIS)

W79-07675

DETECTION OF NAPHTHALENE BY THE BLUE CRAB, CALLINectes sapidus.

National Marine Fisheries Service, Highlands, NJ. Sandy Hook Sport Fisheries Marine Lab.

For primary bibliographic entry see Field 5A.

W79-07676

INTERTIDAL NEAR TAP Bhabha At Health Phys M. C. Balan Journal of India, Vol.

Descriptors: Tides, Beaches, Shores, Sea, Zinc, Potassium, chains, Crabs

Surveys were August 1979 littoral zone Atomic Power station is rotated by a vessel to the south of a small rock over a mile. The near shore clear northwards. Less than 100 ft. Power Station previous years are discharges are monitored the systematic released by the W79-07677

KEPONE: TION IN B Environment S. C. Schim Ogleby, and Estuaries, V. 11 ref.

Descriptors: *Kepone, *Cetes, *Tis Blue crabs, of pollutant kinetics, Mo

Two long-term toxic tests: blue crabs fed Kepone were food. Uptake through the crabs were Kepone-free insecticide on molting contained of study was of Kepone-fed oysters taining 0.15 effects of Kepone on crabs fed 0.15 g/kg oysters for 90 days insecticide oysters compared to those died or mor Kepone-free W79-07679

A MATH UPTAKE ALGAE, Central In (Norway). K. L. Seip, Ecological fig. 4 tab, 1

Descriptors: *Methodology, Algae, Mat pollution c

Effects Of Pollution—Group 5C

INTERTIDAL ECOLOGY OF THE SEA SHORE NEAR TARAPUR ATOMIC POWER STATION, Bhabha Atomic Research Centre, Bombay (India). Health Physics Div. M. C. Balani.

Journal of the Marine Biological Association of India, Vol. 17, No. 1, p 101-106, 1975. 2 fig, 6 ref.

Descriptors: *Nuclear powerplants, *Littoral, Tides, Beaches, Radioisotopes, Intertidal areas, Shores, Seasonal, Oysters, Clams, Manganese, Zinc, Potassium, Iodine, Iron, Strontium, Food chains, Crabs, Tarapur Atomic Power Station.

Surveys were carried out between March 1969 and August 1970 to study the fauna and flora in the littoral zone of the sea shore near the Tarapur Atomic Power Station. The beach adjacent to the station is rocky with a number of tidal pools inhabited by a variety of organisms whereas the beach to the south is mostly sandy and barren except for a small rocky stretch. The tidal range is 6 m and over a mile of beach is exposed during low tide. The near shore currents are very strong and have a clear north-south oscillation with the changing tides. Less *Atherina* sp. fry were available near the Power Station in March 1970 than during the previous year. Possible reasons for these differences are discussed, including the effect of heated discharges on biota. The need is also emphasized to monitor the biota (Plankton, Nekton and Benthos) systematically for content of fission products released by the Power Station. (Deal-EIS) W79-07677

KEPONE: TOXICITY AND BIOACCUMULATION IN BLUE CRABS. Environmental Research Lab., Gulf Breeze, FL. S. C. Schimmel, J. M. Patrick, Jr., L. F. Faas, J. L. Oglesby, and A. J. Wilson, Jr. Estuaries, Vol. 2, No. 1, p 9-15, 1979. 4 fig, 3 tab, 11 ref.

Descriptors: *Toxicity, *Crabs, *Insecticides, *Kepone, *Bioaccumulation, *Depuration, *Callinectes, *Tissue analysis, *James River (Virginia), Blue crabs, Absorption, Animal physiology, Path of pollutants, Oysters, Pesticide residues, Pesticide kinetics, Mortality, Pesticide toxicity.

Two long-term studies were conducted to determine toxicity, uptake and depuration of Kepone in blue crabs (*Callinectes sapidus*). In the first, Kepone was administered to crabs in seawater or food. Uptake of Kepone in 28 days was primarily through the contaminated oysters. When these crabs were held in Kepone-free seawater and fed Kepone-free oysters for 28 days, no loss of the insecticide was evident. There were adverse effects on molting and survival in crabs fed oysters that contained 0.25 micrograms/g Kepone. A second study was conducted to determine: (1) the depuration of Kepone over a 90-day period in blue crabs fed oysters from the James River, Virginia (containing 0.15 micrograms/g Kepone); and (2) the effects of Kepone on molting and survival of blue crabs fed James River oysters or laboratory-contaminated oysters that contained 0.15 or 1.9 micrograms/g Kepone. Crabs fed Kepone-contaminated oysters followed by a diet of Kepone-free oysters for 90 days had detectable concentrations of the insecticide in tissues. Also, blue crabs that ate oysters containing Kepone in concentrations similar to those found in oysters from the James River, died or molted less frequently than crabs fed Kepone-free oyster meats. (Deal-EIS) W79-07679

A MATHEMATICAL MODEL FOR THE UPTAKE OF HEAVY METALS IN BENTHIC ALGAE. Central Inst. for Industrial Research, Oslo (Norway). K. L. Seip. Ecological Modelling, Vol. 6, p 183-197, 1979. 12 fig, 4 tab, 11 ref.

Descriptors: *Heavy metals, *Marine algae, *Methodology, *Mathematical models, *Zinc, Algae, Mathematical studies, Benthic flora, Water pollution effects, Path of pollution, Toxicity,

Chemical analysis, Biomass, Mortality, Sea water, Simulation studies, *Ascophyllum nodosum*.

A mathematical model for the uptake of heavy metals in the benthic algae *Ascophyllum nodosum* has been developed. The model allows assignment of age-dependent growth parameters which also may be a function of external factors. Mortality curves for *A. nodosum* corresponding to a highly polluted and a nearly unpolluted area have been used in the study of metal uptake. Uptake has been simulated for different values of growth parameters and different concentrations of heavy metals in seawater. Emphasis has been on the uptake of zinc. The simulations showed that the concentration of zinc in the algae changed much less (6%) than the biomass (30%) with changes in intrinsic growth rate, mortality and carrying capacity. The concentration in the algae was found to be an approximately linear function of the mean concentration in seawater up to about 100 ppb. At very high concentrations, associated with high mortality, the deviation from linearity may be significant (about 13% at 162 ppb at one locality). The calculation indicates further that variations in the zinc concentration in the seawater are considerably damped in the algae. Simulations have also been performed to study the effects of sampling different parts of the algae, and some initial simulations have been performed to study the effects of heavy metal exchange between algae and sea water. (Katz-EIS) W79-07680

GROWTH DYNAMICS OF CORDGRASS, SPARTINA ALTERNIFLORA, LOISEL, ON CONTROL AND SEWAGE SLUDGE FERTILIZED PLOTS IN A GEORGIA SALT MARSH. Georgia Univ., Sapelo Island. Marine Inst. E. B. Haines. Estuaries, Vol. 2, No. 1, p 50-53, 1979. 4 fig, 1 tab, 13 ref.

Descriptors: *Sewage sludge, *Plant growth, *Growth rates, *Cordgrass, *Spartina, Fertilizers, Sewage sludge disposal, Biomass, Nitrogen, Nitrogen compounds, Seasonal, Salt marshes, Soils, Estuaries.

Seasonal plant growth dynamics were followed for a year in undisturbed plots of tall and short form *Spartina alterniflora* and in plots of short form *S. alterniflora* which were enriched with sewage sludge. Monthly determinations of aboveground live and dead biomass, density of live stems, the ratio of number of young shoots to total number of shoots, and belowground mass of macro-organic matter to a depth of 30 cm were made for each area. Sludge fertilization increased the live biomass of the short form *S. alterniflora* by up to 150% of the control live biomass, but had little effect on the dead biomass, stem density, or proportion of young shoots. There was a trend of increased amount of belowground macroorganic matter in fertilized compared to control plots during the last 6 months of the study. In all areas, there was a marked decrease in the proportion of young shoots from winter to early summer, followed by a rapid increase in the percent of young shoots from late summer to fall. Sampling of plots 7 and 20 months after termination of sludge enrichment showed higher plant biomass and % N content in surface soils, but no difference in N content of live plant tissue, in fertilized compared to unfertilized marsh. After 20 months, about half of the sludge nitrogen remaining in the soils of the fertilized plots had disappeared. (Deal-EIS) W79-07681

DISTRIBUTION OF MIREX IN AN EXPERIMENTAL ESTUARINE ECOSYSTEM. Environmental Research Lab., Gulf Breeze, FL. W. P. Schoor. Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 315-321, 1979. 1 fig, 2 tab, 12 ref.

Descriptors: Pesticide kinetics, *Shrimp, Laboratory tests, Water pollution effects, *Tissue analysis, *Bioaccumulation, *Mirex, *Palaeomonetes, *Thalassia, Pesticide residues, Grasses, Path of pollut-

ants, Estuarine environment, Ecosystems, Gas chromatography, Chemical analysis, Animal metabolism.

The purpose of these experiments was to determine the movement and accumulation of mirex in an experimental ecosystem by utilizing a method of introducing mirex that is representative of what occurs in the natural environment. Experimental aquaria contained sand, grass plants (*Thalassia*) and grass shrimp (*Palaeomonetes*) in artificial seawater. Test aquaria were exposed to varying concentrations of mirex, then sampled over a period of two weeks. Results showed that the shrimp hepatopancreas was the only living component in which the concentration of mirex increased throughout the test period. Small but constant levels were detected in other shrimp tissues and grass, probably due to adsorption. (Deal-EIS) W79-07682

THE EFFECTS OF TEMPERATURE AND DIFFERENT FOOD ORGANISMS ON THE RATE OF GASTRIC EVACUATION IN PERCH (PERCA FLUVIATILIS). Lund Univ. (Sweden). Limnology Inst. L. Persson. Freshwater Biology, Vol. 9, p 99-104, 1979. 3 fig, 4 tab, 23 ref.

Descriptors: *Digestion, *Fish physiology, *Perches, *Water temperature, *Tissue analysis, *Gammarus, Thermal pollution, Fish food organisms, Zooplankton, Diptera, Annelids, Fish diets, Mathematical models, Animal metabolism.

The rate of gastric evacuation in perch was studied at different mean temperatures (range 4.0-21.7 degrees C). Gastric evacuation rates were empirically described by an exponential function and the relationship between the instantaneous evacuation rate and temperature was also exponential. Evacuation rates were not significantly different ($P > 0.1$) for the following food organisms: *Gammarus pulex*, *Chaoborus*, chironomids and zooplankton. The effects of temperature, different food organisms and fish size on the evacuation rates in different fish species are discussed. (Deal-EIS) W79-07683

SOME ECOLOGICAL EFFECTS OF THE VENPET-VENOIL COLLISION. Department of Industries, Sea Point (South Africa). Sea Fisheries Branch. A. Moldan, P. Chapman, and H. O. Fourie. Marine Pollution Bulletin, Vol. 10, p 60-63, 1979. 2 fig, 16 ref.

Descriptors: *Oil spills, *Oil pollution, *Intertidal areas, *Crude oil, *Winkles, *Limpetes, *Barnacles, Path of pollutants, Oil, Organic compounds, Estuaries, Mortality, Tidal effects, Crabs, Beaches, Rivers, Littoral, Estuarine environment, Venpet-Venoil collision, South Africa.

The effects of oil, released after the Venpet-Venoil collision in December 1977, on the intertidal fauna along the South Coast of South Africa have been monitored at monthly intervals since the incident. Localized areas, such as estuaries and sheltered coves, suffered the greatest damage due to the smothering effects of the oil. Damage to the remaining areas has been slight owing to the patchy distribution of the oil together with its physical and chemical characteristics. (Deal-EIS) W79-07684

THE DISTRIBUTION OF HEAVY METALS IN THE HARD CLAM, MERCENARIA MERCENARIA, IN THE LOWER CHESAPEAKE BAY REGION. Bigelow Lab. for Ocean Sciences, Boothbay Harbor, ME. For primary bibliographic entry see Field 5B. W79-07685

MODELLING THE DISTRIBUTION AND EFFECT OF HEAVY METALS IN AN AQUATIC ECOSYSTEM.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

Royal Danish School of Pharmacy Copenhagen.
Dept. of Chemistry.
S. E. Jorgensen.
Ecological Modelling, Vol. 6, p 199-222, 1979. 7 fig, 11 tab, 77 ref.

Descriptors: *Metals, *Heavy metals, *Methodology, *Model studies, *Geosystems, Environmental effects, Path of pollutants, Toxicity, Sediments, Water, Trophic level, Toxicant exchange, Suspended solids, Suspended matter, Adsorption, Reviews, Freshwater fish, Daphnia, Biomass, Lead, Sea water.

Models are reviewed describing the distribution and effect of heavy metals in an aquatic ecosystem. Since a model used for an impact statement should give the maximum concentration level rather than the seasonal variation, a model focussing on this situation is suggested. The basic differential equations describe (1) the variation in concentration of the toxicant per biomass dry matter in a given trophic level, and (2) the exchange of toxicant between sediment and water. Furthermore, since a substantial part of the heavy metal in an aquatic ecosystem is bound to suspended matter, an equation describing the equilibrium between dissolved and suspended matter must be included. A literature review has been carried out on the parameters used in the above mentioned equations and a demonstration, showing how it is possible to find approximate values for such parameters as excretion coefficient and uptake coefficient on the basis of a relationship between these two parameters and the size of an organism, is given. (Katz-EIS)
W79-07686

FACTORS INFLUENCING PH IN LAKE WATER.

Swedish Water and Air Pollution Research Lab., Goteborg (Sweden).
For primary bibliographic entry see Field 5A.
W79-07687

TRANSPORT, DISTRIBUTION AND TOXIC EFFECTS OF POLYCHLORINATED BIPHENYLS IN ECOSYSTEMS: REVIEW.
Tennessee Univ., Knoxville. Memorial Research Center and Hospital.
E. V. Kalmaz, and G. D. Kalmaz.
Ecological Monitoring, Vol. 6, p 223-251, 1979. 5 tab, 80 ref.

Descriptors: *Water pollution effects, *Toxicity, *Chlorinated hydrocarbons, *Environmental effects, Industrial wastes, Path of pollutants, Transport, Transport depletion, Polychlorinated biphenyls, Ecological distribution, Ecosystems, Chemical analysis, Chemical properties, Chemical reactions, Physical properties, Physicochemical properties, Environmental impacts, Ecological magnification, Trophic level.

Investigation of various aspects of the ecological problems of polychlorinated biphenyls (PCBs) has grown and continues to grow with remarkable intensity. However, it appears that certain areas of PCBs research are developed further than the others. For example, chemical and physical behavior and synthesis of PCBs are well studied, while the metabolism of PCBs and other routes of degradation, including toxicological significance and environmental impact, continue to challenge the scientists. In this paper, the chemical and physical properties of PCBs as well as the implications of these properties for the behavior of PCBs in ecological systems are discussed. The effect of PCBs on interrelated ecological systems are described. The distribution and fate of PCBs in the atmosphere, hydrosphere and lithosphere, and transport of PCBs through these systems are discussed. The toxic significance, biological accumulation and ecological magnification are described at various trophic levels. (Katz-EIS)
W79-07688

UPTAKE FROM SEAWATER AND CLEARANCE OF P,P'-DDT BY MARINE PLANKTONIC CRUSTACEA,
Bedford Inst. of Oceanography, Dartmouth (Nova

Scotia). Marine Ecology Lab.
G. C. H. Harding, and W. P. Vass.
Journal of the Fisheries Research Board of Canada, Vol. 36, p 247-254, 1979. 2 fig, 4 tab, 41 ref.

Descriptors: *DDT, *Chlorinated hydrocarbon, *Insecticides, *Zooplankton, Crustacean, Seawater, Biological concentration, Excretion, Clearance rates, Euphausiids, Copepods, Path of pollutants, Water pollution effects, Mathematical studies, Food chain.

A simple exponential model is used to interpret the simultaneous uptake and clearance of p,p'-DDT by euphausiids and copepods to and from seawater. The clearance rate constant for euphausiids, is not significantly different from that observed for copepods. No trend value is detected over the range of p,p'-DDT concentrations in seawater used, 27.8-1388 ng/L. Furthermore, there is a great deal of overlap in the uptake rate constant values between organisms. Uptake rate constants range from 0.76 to 1.21 x 10 to the 4th power/d for euphausiids and from 1.04 to 2.51 x 10 to the 4th power/d for copepods. Knowing levels of Sigma DDT present in planktonic crustaceans in nature, back calculations suggest that there must be < 0.1 ng Sigma DDT/L in seawater. A considerable amount of the Sigma DDT reported in seawater must therefore be unavailable to plankters because it is 'bound' to particles. (Katz-EIS)
W79-07690

CADMIUM SORPTION IN ESTUARINE MUD-TYPE SEDIMENT AND THE ACCUMULATION OF CADMIUM IN THE SOFT-SHELL CLAM, MYA ARENARIA,
District of Columbia Univ., Washington. Mount Vernon Square Campus.
H. L. Phelps.
Estuaries, Vol. 2, No. 1, p 40-44, 1979. 3 fig, 3 tab, 22 ref.

Descriptors: *Cadmium, *Cadmium radioisotopes, *Clams, *Bottom sediments, *Mya, *Tissue analysis, *Bioaccumulation, Humic acids, Bentonite, Absorption, Metals, Path of pollutants, Estuaries, Chemical analysis, Bioassay, Proteins, Animal physiology, Chesapeake Bay.

Young Mya arenaria were exposed to cadmium-109 sorbed to humic acid, bentonite, protein (albumin), mud-type sediment and filtered estuarine water in a 24-hour static assay. After 3 1/2 hours, shells had sorbed twice as much cadmium as tissues. Cadmium-109 was linearly accumulated over 24 hours by Mya exposed to cadmium in estuarine water and bentonite-sorbed cadmium. Protein(albumin)-sorbed cadmium was not accumulated by Mya. Final 24-hour average accumulation levels of sorbed cadmium compared to cadmium in estuarine water were: bentonite-cadmium, 100%; humic acid-cadmium, 60%; mud sediment-cadmium, 33%; albumin-cadmium, 12%. (Deal-EIS)
W79-07691

HYPOTHERMAL MORTALITY IN MARINE FISHES OF SOUTH-CENTRAL FLORIDA JANUARY, 1977,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
R. G. Gilmore, L. H. Bullock, and F. H. Berry.
Northeast Gulf Science, Vol. 2, No. 2, p 77-97, 1978. 4 fig, 3 tab, 51 ref.

Descriptors: *Fishkill, *Cold resistance, *Water temperature, *Hypothermia, Tampa Bay, Indian River, Sanibel Island, Thermal stress, Mortality, Fish physiology, Marine fish, Growth stages, Air temperature, Weather, Fronts(Atmospheric), Florida, Tropical fish.

Comparable climatic conditions on both coasts of central Florida resulted in cold induced fish mortalities from 19 January to 13 February 1977. Lethal temperatures, the species killed and their relative numbers killed are compared for the Indian River lagoon, Tampa Bay and Sanibel Island estuarine systems. Fifty-six species were killed in the Indian River area, 36 in the Tampa

Bay area, while 19 died at Sanibel Island. The higher species mortality in the Indian River lagoon may be attributed to local hydrological and topographical conditions and a richer ichthyofauna. Cold-induced mortality was noted in both juvenile and adult tropical fishes. Some tropical species appear to be more eurythermic than others as lethal minimum temperatures ranged from 6 to 13 C. Hypothermal stress and mortality were observed in offshore reef fishes. (Deal-EIS)
W79-07692

PLANKTON OF THE HOOGHY ESTUARY WITH SPECIAL REFERENCE TO SALINITY AND TEMPERATURE,
Central Inland Fisheries Research Inst., Barrackpore (India).
S. B. Saha, B. B. Ghosh, and V. Gopalakrishnan.
Journal of the Marine Biological Association of India, Vol. 17, No. 1, p 107-120, 1975. 6 fig, 6 tab, 6 ref.

Descriptors: *Phytoplankton, *Zooplankton, *Salinity, *Water temperature, Plankton, Diatoms, Seasonal, Rivers, Estuarine environment, Copepods, Commercial fishing, Cyanophyta, Chlorophyta, Monsoons, Rotifers, India, Hooghly Estuary, Hooghly River, Matlah River.

The results of investigations conducted on the plankton fluctuations in the Hooghly-Matlah estuarine system are presented. The upper zones of rivers Hooghly and Matlah have been found to be rich in phytoplankton. Taking the entire estuarine system, generally two peaks of phytoplankton abundance, with yearly variations in their magnitude are observed, the diatoms playing the most important part in determining the pattern of seasonal variations. Among the zooplankters, copepods form the dominant group. Two annual peaks of abundance have also been observed in the case of zooplankton abundance. The surface water temperature of the estuarine system varied between 19.0C and 32.5C, with the annual range of variation between 7.7C and 12.08C. The salinity varied from traces to 32.77‰ in different zones. Information so far gathered on the plankton in this major estuarine system, in relation to salinity and temperature fluctuations, is reviewed and discussed, with special reference to the fisheries potential of the area. (Deal-EIS)
W79-07693

ESTUARIES,
University Coll. of Swansea (Wales). Dept. of Botany.
For primary bibliographic entry see Field 2L.
W79-07722

PETROLEUM INDUSTRY IN THE DELAWARE ESTUARY,
Academy of Natural Sciences of Philadelphia, PA.
For primary bibliographic entry see Field 2L.
W79-07725

DEVELOPER'S HANDBOOK,
Connecticut Dept. of Environmental Protection, Hartford. Coastal Area Management Program.
For primary bibliographic entry see Field 6B.
W79-07735

SURVIVAL OF EUGLENA GRACILIS EXPOSED TO SUBLETHAL TEMPERATURE AND HEXAVALENT CHROMIUM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
W. H. Yongue, Jr., B. L. Berrent, and J. Cairns, Jr.
Journal of Protozoology, Vol. 26, No. 1, p 122-125, 1979. 4 fig, 3 tab, 12 ref.

Descriptors: *Chromium, *Toxicity, *Water pollution sources, *Temperature, *Lethal limit, *Euglena, Microorganisms, Laboratory tests, Heat resistance, Thermal stress, Water quality.

The joint effects of exposure to various concentrations of chromium trioxide and to sublethal temperature were examined on Euglena gracilis. The

experiments highest temperature for three chromium trioxide survival effects of the chromium concentration limited by the ppm or less sewage; the drinking water gracilis survival concentration of room temperature were kept for chromium active to 0.0005 neous exposure chromium resulted in the end of the three were the last the lethal of lower than drinking water W79-07770

DISTRIBUTION OF FLORIDA NUTRIENT SCIENCE.
Nevada Univ. Sciences.
W. D. Taylor, Hilgert, and Available for Service, Sp. Price codes. Report No. 117 p, 4 tab.

Descriptors: ton, *Lakes, Environmental pollution, Ecological magnification, guard's trop. indices.

The species lakes were Survey in between all individual (1) lake sewage treatment retention time were selected on lake nutrient input limnologist gardd's Trophic and d. The computational phyto species W79-07771

RESULTS MAXSON TRIAL C NESSEE, For primary W79-07788

THE SA WASTEWA MANAGE NICAL A IMPLICA WASTEWA For primary W79-07869

THE ECO CYANIDE

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

experiments were performed to determine the highest temperature at which the organisms survive for three hours, the highest concentration of chromium trioxide at which most of these organisms survive for three hours, and the combined effects of the determined temperature and chromium concentration on the organisms. Chromium trioxide with hexavalent chromium appears relatively stable in water, but is more toxic than other chromium oxides due to its oxidizing potential and ease of penetration of biological membranes. The concentration of hexavalent chromium has been limited by the Water Quality Act of 1965 to five ppm or less in waters discharged into municipal sewage; the allowable concentration standard for drinking water is less than 0.05 ppm. Most *Euglena gracilis* survived a three hour exposure to a concentration of 1 mg/liter of chromium trioxide at room temperature, or 20C. When the flagellate were kept for one hour at 31.5C and exposed to chromium at room temperature they were as sensitive to 0.001 mg/liter as to 10 mg/liter. Simultaneous exposure to 31.5 plus or minus 0.5C and chromium concentrations down to 0.001 mg/liter resulted in less than 50% *Euglena* survival at the end of three hours. The most important results were the lasting effect of sublethal temperature and the lethal effect of chromium at concentrations lower than the 0.05 mg/liter legal standard for drinking water. (Davison-IPA)
W79-07770

DISTRIBUTION OF PHYTOPLANKTON IN FLORIDA LAKES,

Nevada Univ., Las Vegas. Dept. of Biological Sciences.
W. D. Taylor, F. A. Hiatt, S. C. Hern, J. W. Hilgert, and V. W. Lambou.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-296 504. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA-600/3-78-085, September 1978. 117 p, 4 tab, 11 ref, 1 append.

Descriptors: *Aquatic microbiology, *Phytoplankton, *Lakes, *Eutrophication, Outlets, Sewers, Environmental effects, Water quality, Florida, Water pollution effects, Distribution, Sampling, Nygaard's trophic indices, Palmer's organic pollution indices.

The species and abundance of phytoplankton in 40 lakes were sampled by the National Eutrophication Survey in Florida to ascertain the relationships between algal characteristics and trophic status of individual lakes. The lake selection criteria included: (1) lakes impacted by one or more municipal sewage treatment plant outfalls; (2) lakes of 40 hectares in size or larger; and (3) a mean hydraulic retention time of at least 30 days. Sampling sites were selected on the basis of available information on lake morphometry, potential major sources of nutrient input, and on-site judgement of the field limnologist. Results include the calculation of Nygaard's Trophic State Index, Palmers Organic Pollution and species diversity and abundance indices. The computer generated appendix contains alphabetical phytoplankton lists, and also lists taxa without species names. (Davison-IPA)
W79-07771

RESULTS OF INVESTIGATIONS, T. E. MAXSON WTP AND SIGNIFICANT INDUSTRIAL CONTRIBUTORS, MEMPHIS, TENNESSEE,

For primary bibliographic entry see Field 5B.
W79-07788

THE SAN FRANCISCO BAY DELTA WASTEWATER AND RESIDUAL SOLIDS MANAGEMENT STUDY, VOLUME VI. TECHNICAL APPENDIX. THE PUBLIC HEALTH IMPLICATIONS OF LAND APPLICATION OF WASTEWATER AND RESIDUAL SOLIDS,

For primary bibliographic entry see Field 5E.
W79-07869

THE ECONOMIC IMPACT OF ALTERNATIVE CYANIDE STANDARDS IN ILLINOIS,

IIT Research Inst., Chicago, IL.
For primary bibliographic entry see Field 6E.
W79-07885

CONSERVATION DISTRICTS AND 208 WATER QUALITY MANAGEMENT-NON-POINT SOURCE IDENTIFICATION AND ASSESSMENT, SELECTION OF BEST MANAGEMENT PRACTICES, MANAGEMENT AGENCIES, REGULATORY PROGRAMS,

National Association of Conservation Districts, Washington, DC.
For primary bibliographic entry see Field 4A.
W79-07886

COAL MINE WATER POLLUTION - LEGAL AND REGULATORY ISSUES: A SURVEY,

For primary bibliographic entry see Field 5B.
W79-07887

NATIONAL WATER QUALITY GOALS CANNOT BE ATTAINED WITHOUT MORE ATTENTION TO POLLUTION FROM DIFFUSED OR 'NONPOINT' SOURCES,

General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 2E.
W79-07889

GROUND AND SURFACE WATER IN NEW MEXICO: ARE THEY PROTECTED AGAINST URANIUM MINING AND MILLING,

For primary bibliographic entry see Field 6E.
W79-07896

ACID COAL MINE DRAINAGE: PAST POLLUTION AND CURRENT REGULATION,

West Virginia Univ., Morgantown. Coll. of Law.
For primary bibliographic entry see Field 6E.
W79-07905

COMPLETION OF SHELLED MICROZOOBENTHON SAMPLES,

Rice Univ., Houston, TX. Dept. of Geology.
R. E. Casey, C. Hueni, A. Leavesley, J. Gervitz, and R. Schwarzer.
In: 'Environmental Studies, South Texas Outer Continental Shelf, Biology and Chemistry,' Texas University Marine Science Institute, Supplemental Reports to Contract AA550-CT6-17, to the Bureau of Land Management, p 1-1 -1-82, 1979. 14 fig, 4 tab, 6 ref, append. AA550-CT6-17.

Descriptors: *Texas, Benthos, *Sediments, *Silt-ing, *Sites, Water pollution effects, Drilling. Resources development, Baseline studies, *Outer Continental Shelf, *Foraminifera, Benthonic foraminifera, Bolivina lowmani, Ammonia beccarii, South Texas Outer Continental Shelf(STOCS).

The South Texas Outer Continental Shelf was sampled for living benthonic foraminiferans at 12 stations during three seasons in 1975. During 1976, 29 stations were sampled during three seasons and 10 of these stations were sampled during six monthly cruises. These samples were processed and living benthonic foraminiferans were picked, counted, identified and the data evaluated via cluster analysis and maps of density, diversity and richness. The significant findings include: the division of benthonic foraminiferans into groups or individuals characteristic of such features as near-shore-offshore, seasonality, regions of the shelf such as the modern mud blanket, etc. Findings that may prove useful for site evaluation or monitoring include: the use of *Bolivina lowmani* as an indicator of siltling and bottom current movement, the use of *Ammonia beccarii* and other species to indicate perturbations in the water column and sediments, and the suggestion that the bank stations may represent a region very susceptible to man's activities. (Sinha-OEIS)
W79-07915

ANALYSES OF 1975-76 MICROZOOPLANKTON SAMPLES FROM TRANSECT II,

Texas Univ. at Austin, Port Aransas. Port Aransas

Marine Lab.
For primary bibliographic entry see Field 5G.
W79-07916

DETERMINATION OF AVERAGE DRY WEIGHTS OF IMPORTANT NEUSTON SPECIES COLLECTED IN 1976,

Texas A and M Univ., College Station.
J. H. Wormuth.
In: 'Environmental Studies, South Texas Outer Continental Shelf, Biology and Chemistry,' Texas University Marine Science Institute, Supplemental Reports to Contract AA550-CT6-17, to the Bureau of Land Management, p 3-1 -3-37, 1979. 15 fig, 6 tab, 2 ref. AA550-CT6-17.

Descriptors: *Texas, *Ecology, *Plankton, *Biota, *Temporal distribution, *Spatial distribution, Baseline studies, Resources development, Water pollution effects, *Outer Continental Shelf, Diversity index, Species composition.

Dry weights per individual of a number of neuston taxa, considered to be ecologically important, were determined and then used in conjunction with the actual concentrations to give estimates of dry weights of the 1976 winter through April samples. In addition, analyses of variance were run to look at diel, seasonal and spatial variability; factor analysis was used to look at species groupings; comparisons of neuston and zooplankton data were made; and plots of seasonal variation of selected species means along Transect II were made. Groups of species which respond to the environment in similar ways are defined. The relationships of these groups to other parameters are not apparent in the 1976 data, but most of the other parameters were measured on different cruises than those on which the neuston samples were collected. (Sinha-OEIS)
W79-07917

BUREAU OF LAND MANAGEMENT SOUTH TEXAS OUTER CONTINENTAL SHELF REPORT OF CONSULTANCY ON BENTHIC ECOLOGY PROGRAMME - 22 AUGUST - 11 SEPTEMBER AND 24 OCTOBER - 5 NOVEMBER,

Marine Lab., Aberdeen (Scotland).
A. D. McIntyre.
In: 'Environmental Studies, South Texas Outer Continental Shelf, Biology and Chemistry,' Texas University Marine Science Institute, Supplemental Reports to Contract AA550-CT6-17, to the Bureau of Land Management, p 5-17 -5-38, 1979. AA550-CT6-17.

Descriptors: *Texas, *Benthos, *Ecology, *Water pollution effects, Baseline studies, Environmental effects, Leases, Oil pollution, Monitoring, *Outer Continental Shelf, Petroleum development, South Texas Outer Continental Shelf(STOCS).

Work done to date in the benthos ecology programme is reviewed, giving particular attention to an evaluation of data collected during the first three years, and examining possible future developments. The aims are to achieve an understanding of how to assess and control the impact of petroleum exploitation and development in the STOCS area, and in particular to protect the living marine resources from deleterious effects, the overall aim being the general management of the OCS leasing programme. The research considered falls mainly into two parts - in general surveys of first the macrobenthic infauna and second the epifauna, but two related programmes, on regions of topographic highs and on the monitoring of drilling rig effects, are also included. (Sinha-OEIS)
W79-07918

MACROINVERTEBRATE STUDY,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
J. Holt, J. S. Holland, and P. Cotter.
In: 'Environmental Studies, South Texas Outer Continental Shelf, Biology and Chemistry,' Texas University Marine Science Institute, Supplemental Reports to Contract AA550-CT6-17, to the Bureau of Land Management, p 6-1 -6-28, 1979. 18 fig, 1

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

tab. AA550-CL6-17.

Descriptors: *Texas, *Invertebrates, *Benthos, *Ecology, Baseline studies, Water pollution effects, Environmental effects, Resources development, *Outer Continental Shelf, *Population density, Spatial variation, Temporal variation, South Texas Outer Continental Shelf(STOCS).

Benthic invertebrate data from the STOCS were examined for spatial and temporal variation in abundance. Species which were characteristic of station groups and which showed strong variation in population density were studied. Samples collected in 1976 were retrieved and individuals sexed and measured. Length-frequency histograms of all species measured are presented. Variations in epifaunal abundance due to recruitment of young size classes into the study area were verified. Infaunal data analysis did not show seasonal peaks of reproduction possibly because generation time of infaunal organisms is short. Simple linear regressions of mean length of an epifaunal species against physical variables revealed significant correlations with depth, salinity and grain size parameters. Preliminary examination of non-linear, multi-variate analysis shows it to be a useful tool for explaining the distribution of a species. (Sinha-OEIS) W79-07919

BIOMASS MEASUREMENTS OF BENTHIC INVERTEBRATES,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
J. S. Holland, J. Holt, P. J. Cotter, P. B. McDonald, and S. McBride.
In: 'Environmental Studies, South Texas Outer Continental Shelf, Biology and Chemistry,' Texas University Marine Science Institute, Supplemental Reports to Contract AA550-CT6-17, to the Bureau of Land Management, p 7-1 - 7-23, 1979. 8 tab, 7 ref. AA550-CT6-17.

Descriptors: *Texas, *Biomass, *Benthos, *Invertebrates, Baseline studies, Water pollution effects, Resources development, Environmental effects, *Outer Continental Shelf, Petroleum development, Biomass distribution, South Texas Outer Continental Shelf(STOCS).

Biomass, measures as wet weight, of 19 epifaunal species and 14 infaunal species for nine monthly and seasonal collections during 1976, was assayed. Distribution of biomass spatially and temporally was analyzed and regression of biomass on numbers of individual by species was obtained. Total sample biomass was distributed according to depth for both epifauna and infaunal organisms. Infauna exhibited a gradient in total biomass inversely proportioned to depth. Epifaunal biomass decreased precipitously in the deepest of the zones while remaining essentially the same in the two shallow zones. Analysis of variance on raw biomass and standing crop data showed no significant differences in total biomass with season or with transect. Biomass of individual species showed several interesting patterns. Infaunal species were either basically shallow-water species grading into deeper zones or the reverse. Epifaunal species exhibited several other biomass distribution patterns including apparent mid-depth species which exhibited decreased biomass in both shallower and deeper zones. Mean collection biomass exhibited possible recruitment periods for a limited number of species, with no significant pattern for most. (Sinha-OEIS) W79-07920

ADDENDUM TO HISTOPATHOLOGY OF DEMERSAL FISHES. HISTOPATHOLOGY OF MICROPOGON UNDULATUS (ATLANTIC CROAKER) EXPOSED TO WATER SOLUBLE FRACTIONS OF SOUTH LOUISIANA CRUDE OIL.

Texas A and M Univ., College Station. Dept. of Veterinary Anatomy.
W. E. Haensly, and J. C. Eurell.
In: 'Environmental Studies, South Texas Outer Continental Shelf, Biology and Chemistry,' Texas University Marine Science Institute, Supplemental Reports to Contract AA550-CT6-17, to the Bureau

of Land Management, p 8-1 - 8-10, 1979. 2 tab, 4 ref.

Descriptors: *Texas, *Pathology, *Fishes, *Water pollution effects, Baseline studies, Environmental effects, Resources development, *Outer Continental Shelf, *Crude oil, Demersal fishes, Atlantic croaker, Micropogon undulatus, South Texas Outer Continental Shelf(STOCS).

Histopathologic analyses of approximately 100 Micropogon undulatus (Atlantic croaker) exposed to water soluble fractions of South Louisiana crude oil were made. Five fish were exposed to two solutions (5 and 10% of a stock solution) for 1, 3, 7, 14 and 21 days. Samples of liver, kidney, heart, skeletal muscle, stomach, gonad and gill were collected following the various periods of exposure. Most of the organ samples obtained from fish exposed to varying concentrations of water soluble fractions of South Louisiana crude oil did not show lesions that could be attributed to the oil. Two of the organs, gill epithelium and liver, and possibly a third organ, the subcutaneous areas, did show a response to the crude oil. The fact that some organs did not demonstrate a response and that others showed a minimal response suggests that the lengths of exposure, the concentrations used, or both exposure and concentrations, were too low to permit severe lesions to occur. (Sinha-OEIS) W79-07921

AN INTENSIVE STUDY OF THE HEAVY HYDROCARBONS IN THE SUSPENDED PARTICULATE MATTER OF SEAWATER,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
For primary bibliographic entry see Field 5B. W79-07922

FATE OF PETROLEUM-DERIVED AROMATIC COMPOUNDS IN SEAWATER HELD IN OUTDOOR TANKS,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
J. K. Winters.
In: 'Environmental Studies, South Texas Outer Continental Shelf, Biology and Chemistry,' Texas University Marine Science Institute, Supplemental Reports to Contract AA550-CT6-17, to the Bureau of Land Management, p 12-1 - 12-77, 1979. 20 fig, 29 tab, 4 ref. CC550-CT6-17.

Descriptors: *Texas, *Oil spills, *Aromatic compounds, Water pollution effects, Resources development, Environmental effects, Baseline studies, *Outer Continental Shelf, *Petroleum development, Alkanes, South Texas Outer Continental Shelf(STOCS).

Two simulated oil spills (300 and 100 PPM) were conducted in 7000 liter outdoor tanks. A mixture of aromatic compounds was added to a tank in a third experiment. Dissolved and particulate fractions of seawater were analyzed by gas chromatography and combined gas chromatography-mass spectrometry. Results showed that the concentration of petroleum derived alkanes was approximately ten times greater in particulate fractions. Aromatics were generally at least five times more concentrated in dissolved fractions. Aromatic compounds were partitioned between dissolved and particulate fractions with parent and mono-methyl compounds enriched in dissolved fractions while more highly methylated compounds were enriched in particulate fractions. (Sinha-OEIS) W79-07923

DEVELOPMENT OF MINI-COMPUTER PROGRAMMING TO AID IN INTERPRETATION OF MASS SPECTRAL DATA,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
For primary bibliographic entry see Field 5A. W79-07924

DEVELOPMENT OF A CHELATING/CO-PRECIPITATION PROCEDURE FOR MATRIX-

FREE ANALYSIS OF VARIOUS METALS IN ORGANISMS FROM THE SOUTH TEXAS OCS BY ATOMIC ABSORPTION SPECTROPHOTOMETRY,

Texas A and M Univ., College Station. Dept. of Oceanography.
For primary bibliographic entry see Field 5A. W79-07925

BIOLOGICAL CHARACTERIZATION OF THE NEPHELOID LAYER,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
D. Kamykowski, J. Batterton, J. Bird, R. Jordan, and S. Milton.
In: 'Environmental Studies, South Texas Outer Continental Shelf, Biology and Chemistry,' Texas University Marine Science Institute, Supplemental Reports to Contract AA550-CT6-17, to the Bureau of Land Management, p 15-1 - 15-86, 1979. 29 fig, 15 ref, 3 append. CC550-CT6-17.

Descriptors: *Texas, *Phytoplankton, *Biomass, *Water pollution effects, Oil pollution, Baseline studies, Resources development, Environmental effects, *Outer Continental Shelf, *Nepheloid layer, Species composition, Petroleum development, South Texas Outer Continental Shelf(STOCS).

A single station (near STOCS 4/II) was sampled for 24 hour periods on 29-30 June, 24-25 July, 25-26 September and 8-9 November 1978. Samples surveyed turbidity, light transmission, temperature, salinity, plant nutrients, plant biomass, species abundances, and near bottom 14C uptake. A variable nepheloid layer was encountered during each cruise; only the first two cruises had associated phytoplankton abundances. These phytoplankton accumulations were composed of both pelagic and benthic species. Net 14C uptake was detected within these layers under in situ conditions. Evidence suggests that this layer may be especially vulnerable to energy related activities. It is speculated that oil introduced into the near bottom layer probably will affect the species composition and net production of the phytoplankton community either through direct toxicity or through detrimental effects on light conditions, nutrient conditions or grazers. The ecosystem impact of changes in this phytoplankton reservoir will depend on the alternate choices available to grazers. (Sinha-OEIS) W79-07926

ENVIRONMENTAL STUDIES, SOUTH TEXAS OUTER CONTINENTAL SHELF, BIOLOGY AND CHEMISTRY. VOLUME III - APPENDICES A-F,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
Final Report 1977 to the Bureau of Land Management, January 15, 1979. 823 p. AA550-CT7-11.

Descriptors: *Texas, *Hydrography, *Data collections, Zooplankton, Biota, Metals, Sediments, Oil pollution, Water pollution effects, Resources development, Baseline studies, Environmental effects, *Outer Continental Shelf, Petroleum development, South Texas Outer Continental Shelf(STOCS).

A study of the South Texas Outer Continental Shelf (STOCS) was conducted on behalf of the U.S. Bureau of Land Management. This, the third volume, contains appendices A through F, and consists of data resulting from the following projects: (A) Hydrographic Project: Calibrated temperature and salinity values from the 1977 sampling program and computed hydrographic variables; (B) Low-molecular-weight hydrocarbon and hydrographic project; (C) High-molecular-weight hydrocarbons in zooplankton, sediment and water; (D) Heavy molecular weight hydrocarbons in macroepifauna and macronekton; (E) Trace metals project; and (F) Sediment Texture. (Sinha-OEIS) W79-07927

ENVIRONMENTAL STUDIES, SOUTH TEXAS OUTER CONTINENTAL SHELF, BIOLOGY AND CHEMISTRY. VOLUME IV - APPENDICES G-I,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
Final Report, January 15, 1979.

Descriptors: *Benthos, *Water pollution effects, Environmental effects, Continental shelf, Transport, Shelf(STOCS).

A study of the South Texas Outer Continental Shelf (STOCS) was conducted on behalf of the U.S. Bureau of Land Management. This, the fourth volume of the series, contains appendices G through I, and consists of data resulting from the following projects: (G) Water microbiology project; (H) Sediment texture project; and (I) Sediment transport project. (Sinha-OEIS) W79-07928

ENVIRONMENTAL STUDIES, SOUTH TEXAS OUTER CONTINENTAL SHELF, BIOLOGY AND CHEMISTRY. VOLUME V - APPENDICES J-M,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
Final Report, January 15, 1979.

Descriptors: *Benthos, *Water pollution effects, Environmental effects, Continental shelf, Transport, Shelf(STOCS).

A study of the South Texas Outer Continental Shelf (STOCS) was conducted on behalf of the U.S. Bureau of Land Management. This, the fifth volume of the series, contains appendices J through M, and consists of data resulting from the following projects: (J) Shelled mollusks project; (K) Litter project; (L) Oil spill project; and (M) Sediment transport project. (Sinha-OEIS) W79-07929

ENVIRONMENTAL STUDIES, SOUTH TEXAS OUTER CONTINENTAL SHELF, BIOLOGY AND CHEMISTRY. VOLUME VI - APPENDICES N-S,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
Final Report, January 15, 1979.

Descriptors: *Pathology, *Water pollution effects, Baseline studies, Environmental effects, Continental shelf, Transport, Shelf(STOCS).

A study of the South Texas Outer Continental Shelf (STOCS) was conducted on behalf of the U.S. Bureau of Land Management. This, the sixth volume of the series, contains appendices N through S, and consists of data resulting from the following projects: (N) Fauna project; (O) Infauna project; (P) Topology project; (Q) Hydrography project; (R) Sediment transport project; and (S) Sediment texture project. (Sinha-OEIS) W79-07930

FEDERAL DEVELOPMENT OF A CHELATING/CO-PRECIPITATION PROCEDURE FOR MATRIX-

Office of DC. Staff Paper.

Descriptors: *Federal abatement effects, Environmental effects, Continental shelf, Transport, Shelf(STOCS).

Effects Of Pollution—Group 5C

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
Final Report 1977 to the Bureau of Land Management, January 15, 1979. 567 p. AA550-CT7-11.

Descriptors: *Texas, *Data collections, *Bacteria, *Benthos, *Water quality, Fungi, Baseline studies, Water pollution effects, Oil pollution, Environmental effects, Resources development, *Outer Continental Shelf, Petroleum development, Oil transport, South Texas Outer Continental Shelf(STOCS).

A study of the South Texas Outer Continental Shelf (STOCS) was conducted on behalf of the U.S. Bureau of Land Management. The fourth volume of six, contains appendices G through I, and consists of data resulting from the following projects: (G) Water column bacteriology; (H) Water column and benthic microbiology; mycology; and (I) Benthic bacteriology. (Sinha-OEIS)
W79-07928

ENVIRONMENTAL STUDIES, SOUTH TEXAS OUTER CONTINENTAL SHELF, BIOLOGY AND CHEMISTRY. VOLUME V - APPENDICES J - M.

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
Final Report 1977 to the Bureau of Land Management, January 15, 1979. 804 p. AA550-CT7-11.

Descriptors: *Texas, *Phytoplankton, *Data collections, *Plankton, *Protozoa, *Zooplankton, *Productivity, Water pollution effects, Environmental effects, Baseline studies, Oil pollution, Resources development, *Outer Continental Shelf, Petroleum development, Oil transport, South Texas Outer Continental Shelf(STOCS).

A study of the South Texas Outer Continental Shelf (STOCS) was conducted on behalf of the U.S. Bureau of Land Management. The fifth volume of six, contains appendices J through M, and consists of data resulting from the following projects: (J) Phytoplankton and productivity; (K) Shelled microzooplankton and general microplankton; (L) Ciliated protozoa; and (M) Zooplankton. (Sinha-OEIS)
W79-07929

ENVIRONMENTAL STUDIES, SOUTH TEXAS OUTER CONTINENTAL SHELF, BIOLOGY AND CHEMISTRY. VOLUME VI - APPENDICES N - S.

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
Final Report 1977 to the Bureau of Land Management, January 15, 1979. 600 p. AA550-CT7-11.

Descriptors: *Texas, *Biota, *Data collections, *Pathology, *Invertebrates, Water pollution effects, Baseline studies, Resources development, Oil pollution, Environmental effects, Fishes, *Outer Continental Shelf, Petroleum development, South Texas Outer Continental Shelf(STOCS).

A study of the South Texas Outer Continental Shelf (STOCS) was conducted on behalf of the U.S. Bureau of Land Management. The sixth volume of the series, contains appendices N through S, and consists of data resulting from the following projects: (N) Neuston project; (O) Meiofauna project; (P) Benthic invertebrates: macroinvertebrates and epifauna; (Q) Demersal fishes; (R) Histopathology of demersal fishes; and (S) Histopathology of invertebrate epifauna. (Sinha-OEIS)
W79-07930

FEDERAL ROLE IN OCS OIL AND GAS DEVELOPMENT.

Office of Technology Assessment, Washington, DC.
Staff Paper, May 1977. 22 p.

Descriptors: *Leases, *Resources development, *Federal government, *Baseline studies, Pollution abatement, Environmental effects, Water pollution effects, Oil pollution, United States, *Outer Continental Shelf, Petroleum development.

The numerous Federal Government related activities which make up the entire OCS leasing and regulating process are set forth as well as estimates for each step. One chart provides an overview of the process in its entirety. Detailed charts describing the process step-by-step are also provided. Finally a bar chart is provided to show the amount of time required by both Government and industry to proceed through the various stages of the OCS oil and gas development process. Separate 'timelines' are provided for both established and frontier areas. Baseline studies are conducted in frontier areas to establish an environmental benchmark to permit continued monitoring after the sale during drilling and production to detect possible adverse effects from these operations. If such adverse effects are detected, additional regulations would be adopted to reduce or eliminate them. Studies cover data on geology, geophysics, biological environment, oceanography and meteorology associated with a particular region where offshore leasing may take place. These studies include original research as well as an analysis of existing information. (Sinha-OEIS)
W79-07931

STUDY DESIGN FOR RESOURCE MANAGEMENT DECISIONS: OCS OIL AND GAS DEVELOPMENT AND THE ENVIRONMENT.

Bureau of Land Management, Washington, DC. Available from Supt. of Documents, GPO, Washington, DC 20402. Price, \$0.00. Stock No. 024-011-00100-0. October 1978. 111 p, 3 fig, 4 tab, 10 ref, 10 append.

Descriptors: *United States, *Resources development, *Water pollution effects, *Environmental effects, Pollution abatement, Gases, Oil spills, Water resources, Planning, Decision making, *Outer Continental Shelf, Petroleum development, Resources management.

This document is an updated statement of the program design for the Bureau of Land Management's (BLM) Outer Continental Shelf (OCS) Environmental Studies Program. The analyses contained in this document are useful for delineating information needs and for establishing program direction, but these are only examples and are not intended to be exhaustive. Chapters three and four and a number of the appendices show a few of the ways in which public issues for a given OCS area can be determined and used to define studies that can provide timely and useful information to the decisionmaker. It is hoped that this document represents a clear statement of the structure and function of the OCS environmental studies program as it exists now, and provides a framework in which changes can be readily accommodated on a regular basis. A glossary of terminology has been provided. (Sinha-OEIS)
W79-07932

THE MICROFOULING PROBLEM AND THE FUTURE OF THE OCEAN THERMAL ENERGY CONVERSION (OTEC) PROGRAM.

Columbia Univ., New York. Dept. of Biological Sciences.
W. A. Corpe.
Marine Technology Society Journal, Vol. 13, No. 1, p 21-25, February-March, 1979. 1 tab, 25 ref.

Descriptors: *Resources development, *Energy conversion, *Fouling, *Sea water, Heat exchangers, Films, Slime, Environmental effects, Water pollution, Electric power, Water pollution effects, *Outer Continental Shelf, *Ocean Thermal Energy Conversion(OTEC).

The Ocean Thermal Energy Conversion (OTEC) concept is looked upon as a potentially important, renewable source of electric power for the future, deserving of study and possible development. The temperature difference between warm surface water and cold deep water at most suitable tropical or subtropical oceanic sites is only about 20 degrees K, so the thermal resistance between seawater and working fluid must be as low as possible so as not to compromise the technical viability of the system. Microfouling in the form of a 'slime layer' invariably develops on all solid

surfaces exposed to seawater. Such films significantly affect the performance of heat exchangers by acting as insulators. Some aspects of marine micro-fouling are discussed and some views are presented about (a) what kind of research effort in microfouling must be undertaken if progress in OTEC development is ultimately to be realized, and (b) what considerations ought to be taken into account when establishing research priorities. (Sinha-OEIS)
W79-07933

OCS DEVELOPMENT AND COMMERCIAL AND RECREATIONAL FISHING.

Resources for the Future, Inc., Washington, DC. E. A. Wilman.
Coastal Zone Management Journal, Vol. 5, No. 3, p 211-230, 1979.

Descriptors: *Resources development, *Fisheries, *Oil spills, *Leases, Environmental effects, Water pollution effects, Fishing grounds, Economics, *Outer Continental Shelf, Petroleum development, Commercial fisheries, Recreational fisheries.

As the controversy over Outer Continental Shelf (OCS) oil and gas leasing continues, with environmentalists and fishermen seeking to block or delay leasing decisions that they think will adversely affect their interests, the need for better estimates of the environmental costs associated with OCS development becomes increasingly apparent. Although high degrees of precision in such estimates may never be economic, let alone feasible, better knowledge would reduce the uncertainty surrounding the magnitude of such costs, and would make it easier to come to grips with the problem and reduce, if not resolve, the controversy. (Sinha-OEIS)
W79-07934

ROOTED AQUATIC PLANTS.

Environmental Protection Agency, Washington, DC. Office of Water and Hazardous Materials. For primary bibliographic entry see Field 5A.
W79-07965

BENTHIC MACROINVERTEBRATES OF THE FRESHWATER POTOMAC.

Maryland Dept. of Natural Resources, Annapolis. Water Resources Administration.
G. H. Harmon.

Interstate Commission on the Potomac River Basin, Rockville, MD. Technical Publication 78-2. In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. D. and Mason, W. T., Eds., 1978. p 29-35, 2 fig, 1 tab, 28 ref.

Descriptors: *Benthic fauna, *Invertebrates, *Aquatic animals, *Potomac River Basin, *Water quality, *Bioindicators, *Water pollution, Water pollution sources, Acid mine water, Sampling, Monitoring, Ecology.

Potomac River benthic invertebrates are sampled in a program conducted by the Maryland Water Resources Administration to provide information applicable to the assessment of trends in water quality. As part of the Baseline Water Quality Monitoring Network (BWQMN) established by the Interstate Commission on the Potomac River Basin, the statewide program consists of 15 sampling locations. Results are reported for each of the 10 mainstream stations above Washington which have been sampled at least once during the past three years. These results show that the benthic macroinvertebrate communities of the Upper North Branch of the Potomac River are impoverished, indicating severely degraded water quality primarily caused by acid mine wastes. The near annihilation of the aquatic communities including fish and most aquatic plants, in addition to the macroinvertebrates, is attributed to the acid mine waters. At Paw Paw and Hancock good-to-excellent water quality is indicated by the diverse benthic communities. A downward trend in water quality and benthic community diversity in the Shepherdstown to Little Falls region is attributed to point discharges and nonpoint runoff. The

Group 5C—Effects Of Pollution

Fish populations of the Potomac River are discussed for the portion of the river from its headwaters near Kempton, Maryland, to Hancock, Maryland, and associated Potomac River tributaries. Acid mine drainage adversely affects the water quality in this region of Maryland, and in turn affects the fish populations of the Potomac River. Because it is extremely toxic to all forms of aquatic life, acid mine drainage, left undiluted, may destroy biological activity for many miles downstream from its discharge point. Past and current studies concerning the Potomac River water quality are cited. Fish samples were taken from seven stations on the North Branch, Potomac River, from three stations on the Potomac River Main Stem, and from 35 tributary stations. No fish were found at the three uppermost stations on the North Branch and 14 tributary stations due to heavy acid mine drainage. Water quality is extremely poor from Kempton to Luke, and remains poor from Luke to McCoolle where three species of minnows were collected. Just upstream from Cumberland seven species of fish were collected, indicating some improvement of water quality. Gradual improvement of water quality was noted from Cumberland to Little Orleans, Maryland; the slight deterioration at Hancock was due to local waste

Although the fishery of the Piedmont Potomac has declined during the past 10 years, the River and its tributaries from the Monocacy to below Little Falls still support a fair resident fishery; there is great spawning potential for anadromous fish in the river below Little Falls. Overfishing, lack of effective fish passages at water supply intakes, flow reduction caused by increased withdrawals, sediment pollution, and stormwater containing contaminants are all probable factors contributing to the decline. A total of 63 fish species are reported for this area of the Potomac River, and of these, four not reported for several years may be extirpated from the Piedmont Potomac. Limiting water supply withdrawals and problems of water quality caused by combined urbanization and agricultural runoff are examined. It is concluded that fish life in the Piedmont Potomac is still a diverse and admirable resource. Specific suggestions are made for the protection and enhancement of this resource. (Davison-IPA)

An environmental survey of the middle Potomac River was conducted from 1956 to 1976 on behalf of the Potomac Electric Power Company (Pepco) and its steam electric station at Dickerson, Montgomery County, Maryland. Mollusks were selected for study because they are a predominant element of the fresh-water macrobenthos, and are widely adaptable to environmental changes. In addition to studying the changes in the mollusk population, the effects of thermal effluents on these invertebrates were examined. Information concerning the numbers of animals present, the location and state of the environment, symbiosis, and condition of the animal is presented for numerous bivalves and gastropods. The severe decline of these populations over the years is attributed to sedimentation.

Descriptors
effects, *V
*Aquatic
Benthos,
sources, W
ment facilit
tion treatm
Eutrophica

Waste Treatment Processes—Group 5D

ation, heightened water temperature, symbiotic relationships, and toxins. Significant changes occurred in 1967 or 1968, and most of the affected mollusks were extirpated or their populations were diminished below recruitment level. At present the inadequate environmental conditions persisting consist of sedimentation, adverse water temperature, the onslaught of exotic organisms, and the effects of toxic pollutants. Thermal effects are local and no longer affect the composition of the community which has been reduced to a core of species notoriously tolerant of environmental disturbances. (Davison-IPA)
W79-07981

EFFECTS OF THERMAL DISCHARGES ON FRESHWATER FISHES,

Ichthyological Associates, Inc., Middletown, DE. Experimental Studies.
J. W. Meldrin, and S. Peterson.
In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978. p 132-136, 5 fig, 32 ref. Interstate Commission on the Potomac River Basin, Rockville, Md. Technical Publication 78-2.

Descriptors: *Water pollution effects, *Thermal pollution, *Fresh water fish, *Water temperature, *Environmental effects, *Entrainment, Thermal powerplants, Ecology, Fish management, Fish behavior, Fish physiology, Aquatic environment.

The use of water by steam electric power generating stations to cool their condensers results in a thermal discharge, the effects of which vary with the type of fish and how that species exploits the environment of that site. The degree of ecological significance of a particular effect is site-specific, and must be evaluated consistent with the ecological potential of the water body. Results of laboratory experiments show that fish have preferred temperatures, i.e., they will avoid temperatures too high or too low. This response varies with the season, species, ambient temperature of the receiving water, and the temperature of the thermal discharge. Light level size also influence avoidance temperature and preferred temperature. Fish seem to prefer thermal plume during the colder months. Crowding resulted in an increased incidence of disease, starvation, and poor condition in some species, but not others. Sudden temperature decreases are of more concern than upped lethal temperatures which will be avoided. Mortalities can occur during the colder seasons if the thermal discharge stops, or if the plume temperatures drop below the temperature tolerance of the species. The effects of secondary (or plume) entrainment on fish eggs and prolarvae are small compared to the other effects. (Davison-IPA)
W79-07982

WATER QUALITY EFFORTS BY CHEMICAL INDUSTRIES,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 5A.
W79-07984

IMPACT OF WASTEWATER TREATMENT PLANT DISCHARGES,

Maryland Univ., College Park. Inland Environmental Lab.
Cf. Tsai.
In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978. p 147-150, 5 fig, 33 ref.

Descriptors: *Sewage effluents, *Environmental effects, *Water pollution effects, Ecosystems, *Aquatic habitats, Fish behavior, Spawning, Benthos, Waste treatment, Water pollution sources, Waste disposal, Sewers, Outfalls, Treatment facilities, Water quality control, Water pollution treatment, Chlorination, Nitrates, Phosphates, Eutrophication.

Chemical composition of sewage treatment plant effluents varies from plant to plant, depending on the sources of sewage, the degree of treatment, and the chemicals added during treatment. The impact of these effluents differs from one receiving stream to another, according to the quality and quantity of the effluent, and the physical and chemical condition of the stream. Sewage effluents often toxic, damage aquatic life through direct toxication. The sludges contained in these effluents are also damaging in that turbidity is increased, fish may receive abrasive injuries and clogged gills, bottom organisms are reduced and modified, and spawning grounds are destroyed. Phosphates and nitrates, the organic nutrients in sewage effluents, increase primary productivity and are beneficial in amounts which can be assimilated into the food chain. Excessive amounts of the nutrients result in water deoxygenation, algal bloom, growth of molds and bacteria, and eutrophication. Events occurring when improperly treated or raw sewage is discharged to a receiving stream are summarized; the effects of proper and improper chlorination are discussed; four types of plants are described; and four types of sewage outfall locations are examined. Because they contain two major resources, water and nutrients, sewage effluents can be reclaimed by crop irrigation, and used as fertilizer, soil conditioners, and compost. It is concluded that the impact of sewage effluents can be damaging or beneficial, depending on the type of sewage produced, how it is treated, and the manner of its disposal. (Davison-IPA)
W79-07985

5D. Waste Treatment Processes

AEROBIC DIGESTION OF WASTE ACTIVATED SLUDGE,

Alley (E. Roberts) and Associates, Brentwood, TN.
C. S. Reece, R. E. Roper, Jr., and C. P. L. Grady, Jr.

Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers. Vol. 105, No. EE2. p 261-272, April 1979. 5 fig, 3 tab, 20 ref, 2 append. OWRT A-033-IND (5).

Descriptors: *Activated sludge, *Aerobic treatment, Sludge, Sludge digestion, Suspended solids.

Activated sludge that had been grown on a completely soluble wastewater in a pilot plant was subjected to aerobic digestion in batch, lab-scale reactors. During the course of digestion, destruction of nonvolatile solids occurred so that it was preferable to express the kinetics of digestion upon the loss of total suspended solids rather than volatile suspended solids. The first-order rate constant for the destruction of degradable suspended solids was found to be unaffected by the solids retention time (SRT) at which the activated sludge had been grown, whereas the nondegradable fraction of the activated sludge was found to increase as the SRT increased.
W79-07581

EXPERIMENTAL DEGRADATION OF CRUDE OIL BY MARINE BACTERIA,

Kobe Univ. of Mercantile Marine (Japan). Research Inst. of Marine Cargo Transportation.
For primary bibliographic entry see Field 5B.
W79-07594

RESIDUAL HEAVY METAL REMOVAL BY AN ALGAE-INTERMITTENT SAND FILTRATION SYSTEM,

Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 5C.
W79-07638

NITROGEN AND PHOSPHORUS REMOVAL FROM SEWAGE EFFLUENT WITH HIGH SALINITY BY CHLORELLA SALINA,

Chinese Univ. of Hong Kong. Dept. of Biology.
K.-Y. Chan, K. H. Wong, and P. K. Wong.
Environmental Pollution, Vol. 18, p 139-146, 1979.

3 fig, 1 tab, 34 ref.

Descriptors: *Microbial degradation, *Chlorella, *Sewage effluent, Salinity, Nitrogen, Phosphorus, Ammonia, Domestic wastes, Waste water treatment, Phosphates, Nitrates, Absorption, Chlorophyta, Secondary treatment, Nutrients, Growth rates.

Cells of *Chlorella salina* CU1 are able to grow well in domestic sewage effluent having salinities as high as 16 ppt. By using controlled *C. salina* CU1 cultures, it is possible to remove the nitrogen and phosphorus from the sewage effluent before it is discharged into marine coastal water. With a retention time of 8 days, 86% to 100% NH₃-N, 98% NO₃-N and 98% PO₄-P are removed from the sewage effluent under laboratory conditions. It is also found that cells of *C. salina* CU1 prefer ammonia to nitrates as nitrogen source. Uptake of nitrates by the cells occurs only after the ammonia in the sewage effluent has been reduced to levels below 0.5 ppm. Ammonia at higher concentrations completely inhibits the nitrate uptake by the algal cells. Since cells of *C. salina* CU1 have a high protein content (44%), it is proposed that this unicellular green alga can be used to serve the dual function of wastewater purification and waste recycling through the production of algal protein from sewage effluent having high salinities. (Davison-IPA)
W79-07643

ACUTE TOXICITY OF DECHLORINATED DDT, CHLORDANE AND LINDANE TO BLUE-GILL (LEPOMIS MACROCHIRUS) AND DAPHNIA MAGNA,

Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.

For primary bibliographic entry see Field 5C.
W79-07671

THE USE OF EVAPOTRANSPIRATION AS A MEANS OF WASTEWATER DISPOSAL,

Tennessee Univ., Knoxville. Dept. of Civil Engineering.
D. W. Weeter.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 767. Price codes: A07 in paper copy, A01 in microfiche. Water Resources Research Center, Tennessee University, Research Report No. 70, May 1979. 136 p, 15 fig, 26 tab, 63 ref, 2 append. OWRT A-053-TENN(1). 14-34-0001-8045.

Descriptors: *Waste water treatment, *Evapotranspiration, *Effluents, Septic tanks, Aerobic treatment, Infiltration rates, Flow rate, Trace elements, Absorption, Methodology, Costs.

A laboratory study, mathematical models, and a literature search were employed to determine the applicability of evapotranspiration to treat on-site disposal of septic tank effluent and aerobically treated effluent. The relative fate of some trace metals within the evapotranspiration bed was determined in the laboratory. Mathematical models were employed in determining the evapotranspiration rates (outflow) and the infiltration rates (inflow) of the proposed evapotranspiration bed. A literature search related soil-groundwater parameters to the inflow-outflow rates and attempted to determine the effective life of the system. Results of the study show that evapotranspiration rates of aerobically digested water are equal to the rates for septic tank effluent; that evapotranspiration is independent of the dry plant matter produced; and the two feed solutions showed equal metal uptake rates. Life expectancy data were inconclusive. A methodology was proposed for an evapotranspiration waste water disposal bed design, but the current literature allowed only an estimate as to the range of bed sizes. It is concluded that the cost of this method is economically justifiable in certain circumstances. (Davison-IPA)
W79-07772

MANAGEMENT OF SMALL WASTE FLOWS,

Wisconsin Univ.-Madison.

Available from the National Technical Information

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Service, Springfield, VA 22161 as PB-286 560, Price codes: A99 in paper copy, A01 in microfiche. Report EPA-600/2-78-173, 1978. 807 p, 235 fig, 251 tab, 411 ref, 5 append.

Descriptors: *On-site collections, *Domestic wastes, *Soil investigations, *Treatment, *Septic tanks, Infiltration, Clogging, Aerobic treatment, Filtration, Flow characteristics, Hydraulic conductivity, Nutrient removal, On-site tests, Waste water treatment, Wisconsin.

A seven-year research project was conducted to conceive, evaluate and develop satisfactory methods of on-site treatment and disposal of waste waters. The study included characterization of household and commercial waste waters, assessment of waste water treatment alternatives dependent or independent of soil design, management of on-site disposal systems, and institutional and regulatory control of on-site systems. Waste water characteristics and flow data were monitored at 11 rural Wisconsin homes over a period of 434 days; the quality of the waste water was monitored for 35 days at four of the sites. Four sand filters, 11 septic tanks, 11 aerobic units, and a chemical unit were evaluated at 10 field sites and in one controlled system with a waste water simulator. Soils were evaluated as a treatment and disposal medium, and for capabilities for removing bacteria, viruses, and nutrients from waste water under different loadings and soil temperatures. The infiltration rates through biologically clogged soils were calculated; methods for reducing clogging in soils were investigated. Field methods of measuring soil hydraulic conductivity were developed and results of the investigations were utilized to improve the design, installation, and operation of both conventional and alternative soil absorption systems. Institutional control strategies for on-site waste management were discussed. (Lisk-FRC) W79-07774

DEMONSTRATION OF A LEACHATE TREATMENT PLANT.
Applied Technology Associates, Philadelphia, PA. R. L. Steiner, J. E. Keenan, and A. A. Fungaroli. Available from the National Technical Information Service, Springfield, VA 22161 as PB-269 502, Price codes: A04 in paper copy, A01 in microfiche. Report, 1977. 67 p, 8 fig, 18 tab, 63 ref, 1 append.

Descriptors: *Landfills, *Leachate, *Chemical precipitation, *Activated sludge, *Neutralization, Nutrients, Linings, Lime, Waste water treatment, Municipal wastes.

Chemical-physical and biological treatment is provided in a demonstration sanitary landfill leachate treatment plant. The physical-chemical treatments include lime precipitation, sedimentation, and air stripping. These processes remove heavy metals, ammonia, and organic materials; neutralization and nutrient supplement with sulfuric acid and phosphoric acid, respectively, enhanced the subsequent biological treatment. Activated sludge is used in the biological treatment. Processing of the leachate from a lined landfill permits discharge of the effluent into the Delaware River. (Lisk-FRC) W79-07775

TREATMENT AND STABILIZATION OF POLYCHLORINATED BIPHENYLS (PCBS) CONTAMINATED WATER AND WASTE OIL-A CASE STUDY. WHITEHOUSE, FLORIDA.
Environmental Protection Agency, Atlanta, GA. Region IV. A. Smith, F. Stroud, and R. Wilkerson. Available from the National Technical Information Service, Springfield, VA 22161 as PB-273 842, Price codes: A03 in paper copy, A01 in microfiche. Report, 1977. 33 p, 19 fig, 4 tab, 1 append.

Descriptors: *Oil wastes, *Activated carbon, *Adsorption, *Filtration, *Polychlorinated biphenyls, Heavy metals, Settling basins, Oily water, Sludge, Treatment facilities, Waste water treatment, Industrial wastes, Florida.

An on-site treatment process was developed for six abandoned waste oil pits in Florida which con-

tained high levels of polychlorinated biphenyls (PCB). Sampling of the ponds, which had a total surface area of about 5 acres and depths ranging from 5-15 ft, indicated they contained a bottom layer of thick oily sludge underlying a layer of water and covered by a layer of oil. Pit pH was 1.0, permitting the PCBs to be soluble in the oil/water mixture. PCB concentrations in the sludge samples ranged 8.7-23.3 ppm and significant levels of copper, lead, zinc, cadmium, and chromium were measured. To reduce PCB levels to within 1 ppb, activated carbon was selected. Because adsorption columns were not considered practical in this instance, a powdered activated carbon adsorption system was developed which incorporated a collection sump, a carbon mixing chamber, a sedimentation basin, and a sand filter. The sump drained the pits into the mixing chamber where carbon was added at 27 ppm to the influent. The carbon-PCB sludge was then transferred to a 22,500 gal stabilization basin for at least 6.25 hrs, followed by filtration through a sand filter. The treated effluent was discharged into the St. Johns River. (Lisk-FRC) W79-07778

LINER MATERIALS EXPOSED TO HAZARDOUS AND TOXIC SLUDGES.
Matrecon, Inc., Oakland, CA. For primary bibliographic entry see Field 8G. W79-07779

ASSESSMENT IN INDUSTRIAL HAZARDOUS WASTE MANAGEMENT PETROLEUM RE-FINING INDUSTRY.
For primary bibliographic entry see Field 5E. W79-07781

CLOSED LOOP SYSTEM FOR THE TREATMENT OF WASTE PICKLE LIQUOR.
Crown Chemical Co., Inc., Indianapolis, IN. J. C. Peterson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-270 090, Price codes: A04 in paper copy, A01 in microfiche. Report EPA-600/2-77-127, 1977. 60 p, 18 fig, 12 tab, 6 ref.

Descriptors: *Acid streams, *Iron oxides, *Crystallization, *Ion exchange, *Oxidation, Hydrolysis, Recycling, Chemical wastes, Resins, Waste water treatment, Industrial wastes.

The conversion of ferrous sulfate, produced by the low temperature crystallization from sulfuric acid waste pickle liquor generated by acid-cleaning steel surfaces, to marketable ferric oxide in a closed-loop system was demonstrated. The closed-loop conversion system contains a crystallizer, an ion exchange unit, an oxidizer, and a hydrolyzer. All acids are recycled with the ferrous sulfate consumed and ferric oxide produced. In the continuous ion exchange unit, the ferrous sulfate solution is contacted with hydrogen ion exchange resin, resulting in 90% removal of ferrous ion. The system produced about 11-15% by weight sulfuric acid for recycle to the pickling process. Regeneration of the resin with 4M HNO₃ produced a ferrous-ferric nitrate solution which was subsequently heated to 180C and contacted with air for complete oxidation to the ferric phase and to oxidize NO₂ to HNO₃. Hydrolysis of this nitrate solution in a continuous coil autoclave at 205C generated ferric oxide and HNO₃. This process produced about 20% by weight HNO₃ which was recycled to the ion exchange unit. The ferric oxide was about 99% pure after drying and had an estimated market value of \$0.10-0.80/kg. (Lisk-FRC) W79-07783

REDUCTIONS IN WATER CONSUMPTION AND FLOW OF SEWAGE - REPORT TO CONGRESS.
Environmental Protection Agency, Washington, DC. For primary bibliographic entry see Field 5F. W79-07785

DEMONSTRATION OF ULTRAFILTRATION AND CARBON ADSORPTION FOR TREATMENT OF INDUSTRIAL LAUNDERING WASTEWATER.
Abcor, Inc., Wilmington, MA. Walden Div. M. H. Kleper, R. L. Goldsmith, and A. Z. Gollan. Available from the National Technical Information Service, Springfield, VA 22161 as PB-287 830, Price codes: A06 in paper copy, A01 in microfiche. Report EPA-600/2-78-177, 1978. 109 p, 16 fig, 26 tab, 8 ref, 3 append.

Descriptors: *Filtration, *Activated carbon, *Laundering, *Waste water treatment, *Performance, Costs, Pilot plants, Industrial wastes, Waste water.

The treatment of industrial laundering wastewaters by ultrafiltration and activated carbon adsorption was investigated. Pilot-scale testing was done at Abcor, Inc., pilot-scale testing was done at a field demonstration site, and an economic analysis was performed of full-scale treatment systems. Non-cellulosic spiral-wound ultrafiltration modules were used in all experiments. A consistently high quality product water was produced. The operation of the spiral-wound ultrafiltration modules was hindered by the fouling tendency of the feed stream. Thus, average module permeate flux was low. This resulted in high capital and operating cost estimates for full-scale treatment systems. For a 100,000 gpd treatment system (assuming 14 gfd flux and 98% water recovery), operating cost was estimated to be \$9.01/1000 gal. Total carbon adsorption costs of \$1.07/1000 gal could be offset by credits gained from reuse of the product water within the laundry. (Small-FRC) W79-07786

COMPATIBILITY OF FLOCCULATING AGENTS WITH RDX/TNT/COMP B.
Picatinny Arsenal, Dover, NJ. Feltman Research Labs.

T. C. Castorina, J. W. McCahill, and A. C. Forsyth. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A035 136, Price codes: A02 in paper copy, A01 in microfiche. Technical Memorandum 2224 1977. 14 p, 3 fig, 3 tab, 3 ref.

Descriptors: *Flocculation, *Explosives, *Polymers, *Compatibility, *Cations, Stability, Chemical reaction, Waste water treatment, Separation techniques, Industrial wastes, Military aspects.

WT2600, WT-2635, CAT-FLOC, CAT-FLOC-T, and E-653 were evaluated as flocculating agents in the treatment of ammunition waste waters containing RDX, TNT, and Comp B. The compatibility of the polymer flocculating agents with the explosives was examined with the standard Compatibility Test. The samples consisted of 2.5 g of explosive and 2.5 g of polymer, or a 50:50 5 g mixture. The samples were placed in a glass heating vial attached to a capillary tube, and the apparatus was evacuated and sealed; the vial was heated at about 100 C for 40 hrs and the volume of gas evolved was recorded. WT-2635 is a cationic homopolymer of ethenimine, WT-2600 is a cationic copolymer of dimethyldiallyl ammonium chloride and acrylamide, CAT-FLOC is a cationic homopolymer of dimethyldiallyl ammonium chloride polyelectrolyte, CAT-FLOC-T is the same as the latter but a liquid with a higher molecular weight distribution, and E-653 is an experimental sulfonated polycarboxylic powder which is hydrolytically stable under acidic conditions at high temperatures and with acidic compounds, including explosives. The results of the tests indicated E-653 was a compatible flocculating agent. (Lisk-FRC) W79-07787

RESULTS OF INVESTIGATIONS, T. E. MAXSON WTP AND SIGNIFICANT INDUSTRIAL CONTRIBUTORS, MEMPHIS, TENNESSEE.
For primary bibliographic entry see Field 5B. W79-07788

Waste Treatment Processes—Group 5D

FINAL REPORT ON FATE OF METALS APPLIED IN SEWAGE AT LAND WASTEWATER DISPOSAL SITES,

Texas A and M Research Foundation, College Station.
For primary bibliographic entry see Field 5B.
W79-07789

THE SURVIVAL OF HUMAN ENTERIC VIRUSES IN HOLDING PONDS,

Texas Univ. at San Antonio. Center for Applied Research and Technology.
B. P. Sagik, S. W. Funderburg, and B. E. Moore.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A034 387, Price codes: A03 in paper copy, A01 in microfiche. Report No. 76-1, 1976. 43 p, 16 fig, 10 tab, 17 ref.

Descriptors: *Viruses, *Ponds, *Sedimentation, *Human diseases, *Separation techniques, Deposition(Sediments), Waste water treatment, Municipal wastes.

Virus removal from municipal waste water in holding ponds has been studied in field models since 1975. Data from the investigation have indicated that the removal of human enteric viruses in holding ponds involves the components of inactivation and sedimentation. One factor identified in the inactivation process, especially for poliovirus inactivation, is higher temperatures. Laboratory investigations and differing field results in the winter and spring months indicate that this primary effect leads to more rapid inactivation. Increased biological activity due to increased sunlight and temperature have a secondary effect on virus survival. This biological activity has an antagonistic effect on the virus communities. Poliovirus appeared in the sediments generated by the holding ponds and further investigations revealed that poliovirus continued to be recovered from the sediments for a long period after they had disappeared from the overlying waters. These findings indicated that viral inactivation may include deposition of particulate-associated virions as a means of virus removal. (Lisk-FRC)
W79-07790

WASTEWATER CHARACTERIZATION AND PROCESS RELIABILITY FOR POTABLE WASTEWATER RECLAMATION,

Dallas Water Utilities Dept., TX.
A. C. Petrasek, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-274 874, Price codes: A07 in paper copy, A01 in microfiche. Report EPA-600/2-77-210, 1977. 124 p, 56 fig, 22 tab, 10 ref.

Descriptors: *Water reuse, *Potable water, *Waste water treatment, *Activated sludge, *Biological treatment, Coagulation, Lime, Carbon dioxide, Gravity, Filtration, Activated carbon, Adsorption, Tertiary treatment, Water quality, Waste quality standards, Municipal wastes.

The performance of a waste water treatment facility producing an effluent product of a quality potentially suitable for potable reuse was evaluated. The reliability of individual unit processes and the effects of process instability on the product water quality were also investigated. The municipal waste water treatment sequence involved screening, dewatering, primary clarification, biological treatment with completely mixed activated sludge, lime coagulation at high pH, single-stage recarbonation with liquid carbon dioxide, gravity filtration, and two-stage activated carbon adsorption. In the pilot plant, the activated sludge influent flow rate was 152 gpm while the flow rate of the product water was 18 gpm. The collection of 24-hr composite samples was performed daily for routing analyses and weekly composite samples were utilized for metals determinations. The quality of the final product water complied in all aspects with the quality criteria of the National Primary Drinking Water Regulations. Process breakdowns or instabilities, such as in the activated sludge system and the mixed-media filter, did not impair the product water quality because of the duplication of the treatment processes. (Lisk-FRC)

W79-07791

TREATMENT OF PRIMARY SEWAGE EFFLUENT BY RAPID INFILTRATION,

Corps of Engineers, Waltham, MA. New England Div.
M. B. Satterwhite, B. J. Condiak, and G. L. Stewart.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A035 390, Price codes: A02 in paper copy, A01 in microfiche. CRREL Report 76-49, 1976. 23 p, 11 fig, 6 tab, 22 ref.

Descriptors: *Infiltration, *Return flow, *Sewage, *Recharge ponds, *Groundwater, Biochemical oxygen demand, *Chemical oxygen demand, Coliforms, Cold regions, Nutrient removal, Phosphorus, Nitrogen, Clogging, Land management, Application methods, Rates of application, Waste water treatment, Municipal wastes.

Rapid infiltration basins were evaluated as a method of treating unchlorinated primary sewage effluent in a cool and humid climate. The untreated effluent was applied to 9 treatment basins for a period of 7 days followed by a rest period of 14 days. The basin inundations resulted in effluent additions totaling about 27 m. In groundwater samples taken from the treatment site and the surrounding area, analyses indicated that total coliform bacteria, BOD, and COD had been removed. Phosphorus concentrations in the samples were about one-third those in the applied primary effluent. In comparison with previous tests, total nitrogen additions to the treatment basins during the 7 day inundation period were 54% higher in these tests. However, groundwater nitrogen levels were comparable for both tests. When longer inundation periods were attempted in an effort to decrease nitrogen concentrations, infiltration capacities of the basins demonstrated a gradual decrease. The reduced infiltration rates were attributed to surface clogging. Proper management was considered necessary for rapid infiltration basins to maintain nitrogen removal in cold climates. (Lisk-FRC)
W79-07792

FEASIBILITY STUDY OF WASTE WATER RECOVERY IN SHRIMP PROCESSING PLANTS,

Economic Development Administration Technical Assistance Project, Report 01-6-09226, 1972, 58 p, 2 fig, 79 ref, 4 append.

Descriptors: *Industrial wastes, *Food processing industry, *Waste water treatment, *Feasibility, *Recycling, Chlorination, Filtration, Settling basins, Gloucester(Mass).

The number and size of shrimp processing plants were determined which might be accommodated by the City of Gloucester water supply system, and the feasibility of possible waste water recovery systems was evaluated. Shrimp processing practices were reviewed, and water use and waste water characteristics of modern shrimp peeling machines were determined. The water quality required for shrimp processing was investigated. Possible waste water treatment and recovery systems were selected for possible further development. Water treatment would possibly include chlorination, filtration, and clarification. Abstracts are provided of literature studied. (Small-FRC)
W79-07794

A METHOD OF MANURE DISPOSAL FOR BEEF PACKING OPERATION,

Procedyne Corp., New Brunswick, NJ.
R. Ricci.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 316, Price codes: A04 in paper copy, A01 in microfiche. Report EPA-600/2-77-103, 1977. 63 p, 17 fig, 6 tab, 11 ref.

Descriptors: *Food processing industry, *Industrial wastes, *Filtration, *Dewatering, *Incineration, Farm wastes, Ultimate disposal, Cattle.

Preliminary studies are described for process design of a system to successfully treat paunch

manure in a beef slaughtering operation. Preliminary studies were conducted to determine paunch manure characteristics, the present disposal system was evaluated, and paunch manure filtration studies were performed. A process designed in which the paunch manure is collected from the slaughtering operation and fed to a screening device which separates the coarse solids. The screenings are dewatered to a solids content of 37%, and the dewatered material is incinerated in a fluid bed incinerator. The liquid from the screening step is fed to a settler and is combined with the liquid stream from the dewaterer prior to sand filtering. The filter cake is also incinerated. The filtrate is recycled back to the settler. (Small-FRC)
W79-07795

SECURING AGRICULTURAL LAND FOR WASTEWATER IRRIGATION,

For primary bibliographic entry see Field 3C.
W79-07796

FIRST ORDER ESTIMATES OF ENERGY REQUIREMENTS FOR POLLUTION CONTROL,

Development Sciences, Inc., Sagamore, MA.
For primary bibliographic entry see Field 6B.
W79-07798

APPLICATION OF SEQUENCING BATCH REACTORS FOR TREATMENT OF MUNICIPAL AND INDUSTRIAL WASTEWATERS (FIRST ANNUAL REPORT, JULY 1, 1976 TO JUNE 30, 1977),

Notre Dame Univ., IN. Dept. of Civil Engineering.
R. L. Irvine.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-273 846, Price codes: A07 in paper copy, A01 in microfiche. Report NSF/RA-770259, 1977. 146 p, 8 fig, 3 tab, 31 ref, 5 append.

Descriptors: *Industrial wastes, *Municipal wastes, *Waste treatment, *Unsteady-flow, *Performance, *Biological treatment, Laboratory tests, Phosphorus, Market value, Computers.

Fill and draw reactors are evaluated in terms of their applicability to a wide variety of treatment areas, and design and control procedures are developed. An attempt is made to develop batch technology as a viable option to conventional continuous flow systems which can satisfy present and future effluent requirements. User market areas are defined. Three primary research products and user areas are actively investigated: (1) Microprocessor control system for batch or continuous flow treatment systems, (2) Single tank batch reactors for small municipalities and small industries in rural areas, and (3) Multiple tank batch reactors for larger municipalities and industries. A micro-computer control system using microprocessors is feasible for small and large treatment systems. Laboratory studies of batch treatment application to high strength wastes demonstrated that the batch system is extremely efficient from a substrate to organism conversion point of view. Also, the development of filamentous organisms and the settling characteristics of the organisms can be controlled in a batch treatment system. The relative growth rate of the filamentous organisms to the remaining organisms was strongly influenced by the waste concentration. Chemical treatment studies of the removal of phosphorus with iron salts found that the batch system developed a better flocculating sludge, was less sensitive to pH, and produced better quality effluent with reduced iron dosages when compared to continuous flow. (Small-FRC)
W79-07800

SHIPBOARD EVALUATION OF A CARLSON MARK 10 CHLORINATOR/MACERATOR SANITARY WASTE-WATER TREATMENT SYSTEM,

David W. Taylor Naval Ship Research and Development Center, Bethesda, MD.
C. S. Alig.
Available from the National Technical Information

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Service, Springfield, VA 22161 as AD-919 175, Price codes: A03 in paper copy, A01 in microfiche. Report 28-939, 1974. 47 p, 7 fig, 10 ref, 5 append.

Descriptors: *Waste water treatment, *Ships, *On-site tests, *Performance, *Chlorination, *Mechanical equipment, Aeration, Maintenance, Regulation, Coliforms.

The Carlson Mark 10 chlorinator/macerator sanitary wastewater treatment system was technically evaluated aboard USS Fidelity (MSO 443). Compliance with effluent quality standards set forth in MIL-S-24201B (SHIPS) was evaluated, as was the ability to obtain reliability and maintainability information. During a 1150-hour test, the system treated 16,600 gallons of wastewater. Over 28% of the samples collected exceeded military standards for effluent coliform bacteria. Eight failures were experienced which resulted in a mean time between failures of 88.5 hours at a 90% confidence interval. The maximum failure repair time was two hours and 40 minutes. Military standards were not met, and the chlorinator/macerator did not satisfy the test plan for reliability and maintainability. Effluent bacterial quality could be improved by increasing chlorination, but then high levels of chlorine would enter receiving waters. A simple preventive maintenance program could reduce system downtime. (Small-FRC) W79-07801

THE EFFECT OF POLYACRYLAMIDE MOLECULAR STRUCTURE ON FLOCCULATION ACTIVITY OF DOMESTIC SEWAGE. Rose-Hulman Inst. of Tech., Terre Haute, IN. Dept. of Chemical Engineering. J. Caskey. Available from the National Technical Information Service, Springfield, VA 22161 as PB-271 016, Price codes: A06 in paper copy, A01 in microfiche. Report GK-43989, 1977. 101 p, 29 fig, 16 tab, 40 ref, 8 append.

Descriptors: *Flocculation, *Polymers, *Suspended solids, *Organic matter, *Molecular structure, Hydrolysis, Hydrogen ion concentration, Sewage treatment, Cations.

The flocculating effectiveness of the branched and linear polymer fractions for suspended solids and organic matter removal was investigated. Linear and branched polyacrylamides were polymerized, the samples were fractionated into different molecular weight portions, and the resulting fractions were hydrolyzed to several anionic levels. Settling rate ratio tests with three weight percent kaolin slurries indicated increased flocculation effectiveness with increased molecular weight in a solution pH of 6.0. The effects of polymer molecular structure were studied on 220 ppm kaolin slurries and domestic sewage, and the polymer did not improve the rate of flocculation. These results confirmed the necessity of multivalent cation addition for effective flocculation of dilute slurries. A linear structure was more effective than a branched structure. Also, increasing molecular weights increased the flocculation effectiveness of the polymer for both linear and branched polymers within the molecular weight range studied. The polymer should be hydrolyzed in the range of 15-30% for optimum effectiveness. (Small-FRC) W79-07805

CYANIDE REMOVAL FROM PETROLEUM REFINERY WASTE WATER USING POWDERED ACTIVATED CARBON. IIT Research Inst., Chicago, IN. J. E. Huff, and J. M. Bigger. Available from the National Technical Information Service, Springfield, VA 22161 as PB-270 862, Price codes: A06 in paper copy, A01 in microfiche. Report, 1977. 107 p, 24 fig, 25 tab, 19 ref, 1 append.

Descriptors: *Activated carbon, *Copper compounds, *Oil industry, *Oil wastes, *Adsorption, Oxidation, Continuous flow, Laboratory tests, Aqueous solutions, Activated sludge, Aerated lagoons, Waste water treatment, Industrial wastes.

Batch and continuous tests were performed to evaluate the treatment of cyanide-bearing refinery

waste waters with powdered activated carbon (PAC) and cupric chloride. The operating parameters of pH, copper dosage, mode of copper addition, carbon dosage, and type of carbon were varied to investigate the basic chemistry and cyanide removal efficiency of the adsorption and catalytic oxidation of cyanide. When the pH was in the neutral range, low equilibrium cyanide in the aqueous solution was achieved while a low copper level was maintained. When solutions containing 0.5 mg/liter iron cyanide were treated with 250 mg/liter PAC and 1.0-1.5 mg/liter of copper, greater than 95% removal of cyanide was achieved in batch tests. In the continuous tests, two laboratory scale activated sludge units were used and carbon and copper were added to the aeration basin. The results of this study indicated that cyanide could be effectively removed by the addition of PAC and cupric chloride to the activated sludge unit without reduction of the biological efficiency of the unit. The treatment process appeared economically attractive for refineries because no capital expenditures are necessary. (Lisk-FRC) W79-07806

EVALUATION OF LEACHATE TREATMENT VOLUME 1: CHARACTERIZATION OF LEACHATE. Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering. E. S. Chian, and F. B. DeWalle. Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 885, Price codes: A11 in paper copy, A01 in microfiche. Report EPA-600/2-77-186a, 1977. 226 p, 47 fig, 18 tab, 34 ref.

Descriptors: *Leachate, *Landfills, *Aerobic treatment, *Anaerobic treatment, *Heavy metals, Degradation, Waste water treatment, Water pollution sources, Activated carbon, Reverse osmosis.

Leachate samples collected from landfills located in the United States were analyzed for organics and inorganics. Also, bench-scale performance data were obtained for selected leachate treatment methods. Leachate from recently constructed landfills was best treated by aerobic or anaerobic processes. Leachate from stabilized landfills was best treated by activated carbon and reverse osmosis. Membrane ultrafiltration, gel permeation chromatography, and specific organic analysis were used on leachate samples to separate different molecular fractions and to determine the main types of organics and associated functional groups. Biological degradation studies revealed the sequential removal of different classes of organics presents in leachate from a recently constructed solid waste lysimeter. In most leachate, high levels of heavy metals were present. Generally, the metal concentrations did not cause toxic effects due to the formation of hydroxides and carbonates in aerobic systems and sulfides and carbonates in anaerobic systems. (See also W79-07808) (Small-FRC) W79-07807

EVALUATION OF LEACHATE TREATMENT VOLUME 2: BIOLOGICAL AND PHYSICAL-CHEMICAL PROCESSES. Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering. E. S. Chian, and F. B. DeWalle. Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 855, Price codes: A05 in paper copy, A01 in microfiche. Report EPA-600/2-77-186b, 1977. 265 p, 86 fig, 20 tab, 4 ref.

Descriptors: *Anaerobic digestion, *Filtration, *Aerated lagoons, *Activated sludge, *Leachate, *Performance, Costs, Biochemical oxygen demand, Activated carbon, Oxidation, Organic matter.

The efficiencies of anaerobic filtration, aerated lagoons, and activated sludge units in removing organic matter from solid waste leachate were investigated. A completely mixed anaerobic filter, in which the effluent is diluted with recirculated effluent, was found to effectively remove organic matter concentrations in high strength, solid waste

leachate over a range of organic loadings and shock loads. Various physical-chemical treatment methods such as chemical precipitation, activated carbon adsorption, and chemical oxidation were investigated and found to be not very effective in removing organic matter. Higher adsorptive capacities were observed for biologically pretreated leachate. Biologically aerated lagoons had TOC removal efficiencies of 96.8-99%, and, had high heavy metal removal rates. The combined treatment of leachate and municipal sludge in a conventional plugflow activated sludge unit effectively treated high strength leachate. Cost estimates were obtained. The aerated lagoon was the least expensive process. The combined treatment of leachate using the activated sludge process had a high dilution factor, especially when leachate BOD levels were low and flow rates were high. (See also W79-07807) (Small-FRC) W79-07808

APPLICATION OF OXYGEN TO TREAT WASTE FROM MILITARY FIELD INSTALLATIONS, PART I: INACTIVATION OF VIRUS IN BENCH-SCALE OXYGENATED WASTE STABILIZATION PONDS. Texas Univ. at Austin. Dept. of Environmental Health Engineering. A. R. Melbard, J. F. Malina, and C. W. Beere. Available from the National Technical Information Service, Springfield, VA 22161 as AD/A-027 092, Price codes: A06 in paper copy, A01 in microfiche. Report, 1974. 112 p, 2 fig, 20 tab, 23 ref, 1 append.

Descriptors: *Viruses, *Sewage bacteria, *Oxygenation, *Oxidation lagoons, *Suspended solids, Chemical oxygen demand, Biochemical oxygen demand, Sewage sludge, Oxygen, Waste water treatment, Municipal wastes.

The application of high purity oxygen to waste stabilization ponds can prevent the reduction of treatment efficiency during overloaded conditions. While stabilization ponds treating municipal wastes may accommodate loadings from 20-70 lbs BOD/acre/day, a loading of 30 lbs BOD/acre/day is considered the average design figure. The effects of oxygenation on the inactivation of enteric viruses and bacteria were studied in a pond incorporating a downflow bubble contact aeration system utilizing pure oxygen. Settled municipal waste water was used as the feed and oxygen transfer efficiencies greater than 95% were achieved. The yield was 0.47 lb volatile suspended solids/lb COD removed; the decay coefficient was 0.02/day. The maximum specific growth rate was 3.7 lb volatile suspended solids produced per pound volatile suspended solids; the half-velocity constant was 281 mg/liter. The system achieved 94.5% BOD removal at substrate removal rates of up to 0.73 lb BOD/lb mixed liquor suspended solids/day. Sludge separation was enhanced by auxiliary mixing and the sludge volume index was 84 ml/g. The introduction of high purity oxygen to the waste stabilization ponds increased the dieoff and inactivation of enteric viruses and bacteria. (See also W79-07810) (Lisk-FRC) W79-07809

APPLICATION OF OXYGEN TO TREAT WASTE FROM MILITARY FIELD INSTALLATIONS PART II: AN EVALUATION OF AN ACTIVATED SLUDGE PROCESS EMPLOYING DOWNFLOW BUBBLE CONTACT AERATION. Texas Univ. at Austin. Dept. of Environmental Health Engineering. A. R. Melbard, J. F. Malina, and C. W. Beere. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A027 034, Price codes: A05 in paper copy, A01 in microfiche. Report 1974. 96 p, 19 fig, 8 tab, 46 ref, 1 append.

Descriptors: *Activated sludge, *Aeration, *Oxygenation, *Pilot plants, *Biochemical oxygen demand, Chemical oxygen demand, Suspended solids, Design criteria, Waste water treatment, Municipal wastes.

The performance of a downflow bubble contact aeration system in an activated sludge waste water treatment system was evaluated. Kinetic coeffi-

Waste Treatment Processes—Group 5D

W79-07812

WASTE WATER TREATMENT BY PHYSICAL AND MECHANICAL METHODS.

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodostazheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidroteologii, Gosstro (USSR).

I. N. Mjasnikov, V. G. Ponomarev, A. P.

Nechaev, and I. V. Kedrov.

In: USA-USSR Working Group on the Prevention of Water Pollution from Municipal and Industrial Sources Symposium on Physical-Mechanical Treatment of Wastewaters, April 5-6, 1977, Cincinnati, Ohio, p 15-22, 1977. 10 fig.

Descriptors: *Sedimentation, *Centrifugation, *Filtration, *Flotation, Waste water treatment, *Performance, Municipal wastes, Industrial wastes, Mechanical equipment.

Waste water treatment by physical and mechanical methods is reviewed, and the results of investigations carried out by VODGEO are mentioned. Sedimentation is discussed. Hydraulic investigations of thin-layer settling tanks that operate according to cross scheme have indicated that maximum efficiency of volume utilization up to 80-90% is achieved when using proportional water distribution devices designed by VODGEO. Pressure hydrocyclones are described, and a hydrocyclone with an internal cylinder and tapered membrane located in the upper part and a multistage hydrocyclone are discussed. Other centrifuges considered include bowl centrifuges, pendulum centrifuges, and scroll centrifuges. VODGEO investigated low-speed centrifuges with a separation factor up to $F = 800$. Flotation treatment methods are described, and filtration of waste water is discussed. VODGEO has found that the use of a filter charged with polyurethane removed 90% of oil from waste water at a filtering rate of up to 20 m/hr. (See also W79-07811) (Small-FRC) W79-07813

PHYSICAL TREATMENT OF OIL REFINERY WASTEWATER.

Environmental Protection Agency, Washington, DC. Office of Research and Development. W. J. Lacy.

In: USA-USSR Working Group on the Prevention of Water Pollution from Municipal and Industrial Sources Symposium on Physical-Mechanical Treatment of Wastewaters, April 5-6, 1977, Cincinnati, Ohio, p 23-26, 1977.

Descriptors: *Activated carbon, *Industrial wastes, *Oil industry, *Adsorption, *Performance, Costs, Chemical oxygen demand, Separation techniques, Oxidation.

Physical treatment is defined, and the results of a demonstration project on activated carbon treatment of refinery effluent are presented. Gravity separation, solvent extraction, adsorption, combustion, and filtration are described. The demonstration treatment system was made up of four main systems plus an impounding reservoir. The water treatment unit reduces the organic COD of water impounded in the refinery prior to discharge. It consists of 12 identical adsorber cells, each cell containing a 4 m deep bed of carbon having a dry weight of approximately 22,100 kg supported by gravel. The carbon regeneration system utilizes selective oxidation of the organic impurities in the pores at high temperatures (900-970°C) and with a controlled low oxygen atmosphere in a multiple hearth furnace. During the two-year project, 172,040,000 gallons of water was processed to load 747,000 kg of carbon with 165,000 kg or COD. The overall operating cost was 49 cents per 1000 gallons of water treated, or 524 kg of COD removed from the water. During the second year, the plant demonstrated the ability to operate at 40 cents per 1000 gallons of water treated. (See also W79-07811) (Small-FRC) W79-07814

IMPROVEMENT OF HYDRAULIC CONDITIONS OF RADIAL SETTLING TANKS,

Vsesoyuznyi Nauchno-Issledovatel'skii, Vodostazheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidroteologii, Gosstro (USSR).

I. V. Skirdov.

In: USA-USSR Working Group on the Prevention of Water Pollution from Municipal and Industrial Sources Symposium on Physical-Mechanical Treatment of Wastewaters, April 5-6, 1977, Cincinnati, Ohio, p 26-30, 1977. 3 fig.

Descriptors: *Sedimentation, *Settling basins, *Hydraulic machinery, *Performance, Design, Waste water treatment.

The advantages of radial settling tanks over other types of settling tanks are discussed, and a new type of radial tank developed in the USSR is described. Radial settling tanks are often utilized at large treatment facilities. The hydraulic conditions of conventional radial settling tanks do not ensure the effective use of most of these installations. The newly developed tank has a water distributing device which rotates continuously with the scraping arm. Hydraulic conditions are improved, installation load can be increased about 1.5 times, and the depth of the tank can be significantly reduced, when the rotatory distributing device is employed. (See also W79-07811) (Small-FRC) W79-07815

CURRENT STATUS AND DIRECTIONS OF DEVELOPMENT OF PHYSICO-MECHANICAL EFFLUENT TREATMENT IN THE PAPER INDUSTRY.

National Council of the Paper Industry for Air and Stream Improvement, Inc., New York. I. Gellman.

In: USA-USSR Working Group on the Prevention of Water Pollution from Municipal and Industrial Sources Symposium on Physical-Mechanical Treatment of Wastewaters, April 5-6, 1977, Cincinnati, Ohio, p 31-39, 1977. 32 ref.

Descriptors: *Pulp and paper industry, *Industrial wastes, *Sedimentation, *Filtration, *Dewatering, Recycling, Activated sludge, Waste water treatment, Sludge treatment, Aeration, Settling basins, Flotation, Biological treatment.

Physico-chemical treatment of effluent in the paper industry is reviewed including: clarification of untreated or biotreated mill effluents by gravity separation or filtration, in-process use of treatment for improved water economy and reduction of organic load, and dewatering and disposal of sludge. Methods for the clarification of biotreated effluents are: Quiescent zone sedimentation in aerated stabilization basin systems, secondary sedimentation for activated sludge treatment systems, secondary flotation for aerated stabilization basin effluent clarification, and media filtration of biologically treated effluents. White water system reuse studies have included combination waste paperboard operations, fine paper manufacture, and tissue and towelling manufacture. Condensate stripping methods include kraft condensate processing and sulfite condensate processing. Current sludge dewatering practices are reviewed. In the future it is likely that total mill effluent clarification at the primary level will be characterized by physico-mechanical methods. At the secondary clarification level, more frequent use of coagulant aids is anticipated to meet water quality standards. Greater internal water reuse is expected, and stripping of condensates from chemical pulp mill liquor evaporation and heat recovery systems will become more extensive. (See also W79-07811) (Small-FRC) W79-07816

EMPLOYMENT OF MICROSTRAINERS IN THE WASTE WATER TREATMENT PRACTICE.

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodostazheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidroteologii, Gosstro (USSR).

I. V. Skirdov, I. A. Sidorova, and Yu. L. Maximenko.

In: USA-USSR Working Group on the Prevention of Water Pollution from Municipal and Industrial

cient calculations indicated that the sludge yield was 0.47 lb volatile suspended solids/lb COD removed, the endogenous respiration coefficient was 0.02/day, the maximum net specific growth rate was 3.7 lbs volatile suspended solids produced/lb volatile suspended solids, and the substrate concentration at half the maximum net specific growth rate was 281 mg/liter. The concentration at half the maximum net specific growth rate was 281 mg/liter. The system removed 94.5% of the BOD, 80.4% of the COD and 70.0% of the suspended solids. Modifications to the system eliminated sludge flotation and significantly improved solids separation. The installation of automatic monitoring and control equipment was considered necessary to maintain longer unattended, uninterrupted service. The design of the system was inflexible to severe changes in the loading; the addition of an equalization basin to overcome high peak loadings may reduce the variability of performance. A pop-off valve to reflow the chamber in the event of phase separation was recommended. Other recommendations for designing pilot plant and large scale activated sludge systems with downflow bubble contact aeration were presented. (See also W79-07809) (Lisk-FRC) W79-07810

USA-USSR WORKING GROUP ON THE PREVENTION OF WATER POLLUTION FROM MUNICIPAL AND INDUSTRIAL SOURCES SYMPOSIUM ON PHYSICAL-MECHANICAL TREATMENT OF WASTEWATERS, HELD AT CINCINNATI, OHIO ON APRIL 5-6, 1977.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-274 663, Price codes: A07 in paper copy, A01 in microfiche. 1977. 144 p, 81 fig, 19 tab, 102 ref. No. 9, Environmental Protection Agency, Washington, DC.

Descriptors: *Industrial wastes, *Municipal wastes, *Waste water treatment, *Sewerage, *Filtration, Settling basins, Incineration.

Thirteen papers were presented on the physical-mechanical methods of waste water treatment. Topics included pyrolysis of municipal and industrial wastes, physical treatment of oil refinery waste water, radial settling tanks, and effluent treatment in the paper industry. Also discussed were: microstrainers, the role of zeta potential in refinery waste waters, Sala-HGMF high gradient magnetic filters, flotation, and tertiary granular filters. The treatment of mining, metallurgical, and oil-chemical wastes, the swirl concentrator, and sewerage in Moscow are also discussed. (See W79-07812 thru W79-07824) (Small-FRC) W79-07811

PYROLYSIS APPLICATIONS FOR INDUSTRIAL AND MUNICIPAL TREATMENT.

Envirotech Corp., Menlo Park, CA. F. P. Sebastian, D. S. Lachman, G. K.

Kroneberger, and T. D. Allen.

In: USA-USSR Working Group on the Prevention of Water Pollution from Municipal and Industrial Sources Symposium on Physical-Mechanical Treatment of Wastewaters, April 5-6, 1977, Cincinnati, Ohio, p 5-14, 1977. 5 fig, 3 tab, 6 ref.

Descriptors: *Ultimate disposal, *Incineration, *Sludge disposal, *Evaluation, Industrial wastes, Municipal wastes, Economics, Regulations, Energy, Water quality.

Pyrolysis in a multiple hearth furnace was investigated and found to have a number of advantages over conventional incineration. This process improves process control and prevents clinker formation. Also, it offers economical energy recovery. Other advantages include increased furnace capacity, potential revenue from stream or power, reduced particulate loading prior to scrubbing, and a permanent solution to solids disposal. The method has numerous industrial applications. Pyrolysis in a multiple hearth furnace meets Environmental Protection Agency emission regulations, and has been proven on a full scale. Bacterial, viral, and organic contamination of groundwater is avoided when thermal destruction methods are used. (See also W79-07811) (Small-FRC)

Group 5D—Waste Treatment Processes

MUNICIPAL SEARCH PR

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Waste Treatment Processes—Group 5D

Water Supply and Sewerage Administration, Moscow (USSR).
P. I. Galanin.

In: USA-USSR Working Group on the Prevention of Water Pollution from Municipal and Industrial Sources Symposium on Physical - Mechanical Treatment of Wastewaters, April 5-6, 1977, Cincinnati, Ohio, p 133-138, 1977. 3 fig.

Descriptors: *Activated sludge, *Municipal wastes, *Sewerage, *Tertiary treatment, Industrial wastes, Biological treatment, Water pollution sources.

Moscow's sewerage and treatment systems are described. The central sewerage system serves 98.5% of the city's population with treatment plants with a total capacity of 4,230,000 cu m/day, 4.3 million cu m/day is subjected to biological treatment. About 40% of this total is industrial wastes. Activated sludge plants are used and the discharging of raw sewage into waterways has almost been eliminated. The activated sludge plants utilize the following scheme: screens, grit chambers, primary settling tanks, aeration tanks, secondary settling tanks. Tertiary treatment is becoming more common. At the activated sludge plants treatment consists of digestion in aerobic digesters at thermophilic conditions (52 C), washing and thickening, coagulation vacuum filtration, and heat drying. Future plans are discussed. (See also W79-07811) (Small-FRC)
W79-07824

HANDLING, TREATMENT AND DISPOSAL OF WASTEWATER SLUDGE.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-258 169, Price codes: A08 in paper copy, A01 in microfiche. Papers presented at USA/USSR Symposium held May 13-16, 1975, Moscow. 1975. 147 p.

Descriptors: *Sludge disposal, *Ultimate disposal, *Industrial wastes, *Municipal wastes, Incineration, Dewatering, Agricultural engineering, Filtration, Oily water, Waste water treatment.

Sixteen papers were presented on the handling, treatment, and disposal of waste water sludge. Topics included sludge incineration, oil sludge treatment, municipal sludge treatment, industrial waste water sludges, sludge thickening and dewatering by vibro filtration, thermal drying of dewatered sludge, dissolved air flotation thickening, and utilization of sludge in agriculture. (See W79-07826 thru W79-07841) (Small-FRC)
W79-07825

POLICY ON MUNICIPAL SLUDGES,

Environmental Protection Agency, Washington, DC. Municipal Construction Div.
For primary bibliographic entry see Field 5F.
W79-07826

SLUDGE INCINERATION SYSTEMS FOR PURIFICATION AND RESOURCE RECOVERY,

Envirotech Corp., Menlo Park, CA.
For primary bibliographic entry see Field 5E.
W79-07827

INDUSTRIAL SLUDGE DISPOSAL PRACTICES,

Environmental Protection Agency, Washington, DC. Industrial Pollution Control Div.
For primary bibliographic entry see Field 5E.
W79-07831

THICKENING AND DEWATERING OF WASTE WATER SLUDGES BY VIBRO FILTRATION METHOD,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrotekhnologii, Gostroy (USSR).
For primary bibliographic entry see Field 5E.
W79-07832

MUNICIPAL SLUDGE MANAGEMENT RESEARCH PROGRAM IN THE U.S.A.,

National Environmental Research Center, Cincinnati, OH. Advanced Waste Treatment Research Lab.
For primary bibliographic entry see Field 5E.
W79-07833

DEWATERING OF SEWAGE SLUDGE BY MEANS OF CENTRIFUGES,

For primary bibliographic entry see Field 5E.
W79-07835

THERMAL DRYING OF DEWATERED SEWAGE SLUDGE,

For primary bibliographic entry see Field 5E.
W79-07836

THICKENING OF SLUDGES,

Delaware Univ., Newark.

R. I. Dick.

In: Handling, Treatment and Disposal of Wastewater Sludge, p 93-100, 1975. 5 fig, 13 ref.

Descriptors: *Sludge treatment, *Dewatering, *Costs, *Design, *Optimization, Sludge disposal, Sedimentation rates, Equations.

Basic sludge thickening concepts are reviewed, and the optimum design for sludge thickeners is examined. The rational basis for design of thickeners is reviewed briefly, and the interaction of thickening with other sludge treatment and disposal processes is examined quantitatively. Thickening greatly influences the cost of sludge treatment and disposal because the cost effectiveness of sludge treatment and disposal techniques depends on the concentration of solids in the sludge. The effect of the design of thickeners on the cost of sludge treatment are discussed. Thickeners should be sized with regard to the thickening properties of the sludge being treated and the settling characteristics of the sludge. An equation is presented for the calculation of required thickener size. (See also W79-07825) (Small-FRC)
W79-07838

DISSOLVED AIR FLOTATION THICKENING AS PRACTICED IN THE U.S.,

Envirex, Inc., Waukesha, WI.

W. N. Konrad.

In: Handling, Treatment and Disposal of Wastewater Sludge, p 101-108, 1975. 7 fig.

Descriptors: *Sludge treatment, *Flotation, *Pilot plants, *Optimization, Design, Flow rates, Suspended solids, Pressure.

Dissolved air flotation thickening secondary of biological sludges has demonstrated its ability to reduce the hydraulic loading on subsequent units. In the United States applications include preceding anaerobic digestion, vacuum filtration, or centrifugation. Design parameters which must be considered in this process are spacing and speed of flights which remove the surface thickening sludge, frequency of removal, tank configuration, source of pressurized flow, and air to solids ratio. High rate loadings and various air to solids ratios were evaluated on a full scale dissolved air thickener. An attempt was made to determine what happens when the air to solids ratio is changed by changing the pressure and then by keeping the same pressure and changing the air to solids ratio by changing the volume of recycle flow which contains the dissolved air. A change in the air to solids ratio by increasing the pressure was detrimental to the operation of the unit, and 40 psig was the optimum operating pressure. The air to solids ratio can be converted directly to a practical design approach by using 100% recycle or pressurized flow for every 1/2% of influent sludge concentration while operating at 40 psig. An air to solids ratio of about 0.015 results. (See also W79-07825) (Small-FRC)
W79-07839

THE DEPENDENCE OF DEWATERING PROCESSES ON AQUEOUS PROPERTIES OF SLUDGES,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vo-

dosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidro-geologii, Gostroy (USSR).
For primary bibliographic entry see Field 1A.
W79-07841

PROCEEDINGS OF THE SEMINAR ON CURRENT APPROACHES IN WASTEWATER TREATMENT.

Held April 5, 1978 at the Ontario Ministry of Health Laboratories, Toronto, Canada. (1978) 140 p, 25 fig, 22 tab, 82 ref. Pollution Control Association of Ontario and the Ontario Ministry of the Environment.

Descriptors: *Sewage treatment, Water treatment, *Grants, *Tertiary treatment, *Dewatering, *Oxidation, Vacuum drying, Nitrification, Activated sludge, Biological treatment, Disinfection, Waste water treatment, Municipal wastes.

Six papers were presented on current processes and methods of evaluating waste water treatment alternatives. Topics discussed included Ontario's grant policy for low-cost alternatives to communal water and sewage treatment, tertiary treatment experience in a region of Canada, operating experience with the Zimpro low-pressure, wet air oxidation unit, treatability studies for initiating nitrification in activated sludge systems, fixed film biological process utilization, and methods of evaluating disinfection alternatives. (See W79-07843 thru W79-07848) (Lisk-FRC)
W79-07842

NEW ONTARIO POLICY FOR LOW COST ALTERNATIVES TO COMMUNAL WATER AND SEWAGE TREATMENT,

Ontario Ministry of the Environment (Toronto).
For primary bibliographic entry see Field 6E.
W79-07843

YORK REGION'S OPERATIONAL EXPERIENCE WITH TERTIARY TREATMENT,

J. W. G. Rupke, J. D. Seldon, and A. T. Robson.

In: Proceedings of the Seminar on Current Approaches in Wastewater Treatment, April 5, 1978, Ontario Ministry of Health Laboratories, Toronto, Canada, p 7-36, 1978. 10 tab.

Descriptors: *Tertiary treatment, *Filters, *Canada, *Settling basins, *Treatment facilities, Dewatering, Cost comparisons, Sands, Coals, Biochemical oxygen demand, Suspended solids, Phosphorus, Waste water treatment, Municipal wastes.

More than half of the 11 municipal waste water treatment plants in the Regional Municipality of York in Canada utilize tertiary treatment. The flows at the treatment plants range from 44-2.40 imperial mgd and utilize gravity or pressure filters; one plant provides tertiary clarification. Filter areas range from 255-20,000 sq ft and utilize single layers or mixtures of anthracite, sand, and/or gravel. Effluent from the plants meet discharge guidelines for BOD, suspended solids, and total phosphorus. While the tertiary clarification system has been relatively trouble free, the operation requires more labor and costs and must be monitored and controlled on a daily basis. The filters must be enclosed in a building whereas the clarifiers may be exposed and may also be used as chlorine contact basins. Tertiary clarifiers may require chemical sludge thickening tanks. (See also W79-07842) (Lisk-FRC)
W79-07844

ROLE OF TREATABILITY STUDIES FOR THE DESIGN AND OPERATION OF NITRIFICATION IN ACTIVATED SLUDGE PLANTS,

Ontario Ministry of the Environment, Toronto. A. G. Smith.
In: Proceedings of the Seminar on Current Approaches in Wastewater Treatment, April 5, 1978, Ontario Ministry of Health Laboratories, Toronto, Canada, p 47-71, (1978). 5 fig, 2 tab, 23 ref.

Descriptors: *Nitrification, *Activated sludge, *Optimization, *Aeration, *Alkalinity, Toxicity,

Group 5D—Waste Treatment Processes

Control parameters necessary for promoting nitrification in activated sludge systems are reviewed as an alternative to the expansion of the aeration basins. Conditions in the reactor must be maintained suitable for the growth of nitrosomas and nitrobacters which convert ammonia to nitrite and nitrate. The activated sludge system may be a single sludge system in which both carbonaceous and nitrogenous oxidation occur simultaneously or a two sludge system where the processes are separated. When the ratios of BOD/total Kjeldahl nitrogen and COD/NH₄-N (C/N) are reduced, increased nitrification per reactor volume may be achieved. Because a high C/N ratio waste water will stimulate heterobacter bacteria growth, this ratio should be reduced to 2:1 to promote nitrifier growth. The optimum pH for the nitrifiers is between 7.2-8.3; nitrification rates increase with increasing pH and may reduce aeration requirements. Effluent alkalinity should be maintained at 50 mg/liter as CaCO₃ for effective nitrification. The nitrification rate improves when dissolved oxygen content is raised from 1 to 2 mg/liter. Chromium, nickel, copper, phenols and other organic materials can be toxic to the nitrifiers at certain concentrations. Lower waste water temperatures will require higher solids retention times. Treatability evaluations, plant influent analysis, historical plant data, and full-scale evaluation are recommended when implementing nitrification in activated sludge. (See also W79-07842) (Lisk-FRC) W79-07846

In: Proceedings of the Seminar on Current Approaches in Wastewater Treatment, April 5, 1978, Ontario Ministry of Health Laboratories, Toronto, Canada, p 73-115. (1978) 17 fig. 4 tab. 42 ref.

The use and performance of fixed film biological reactors are discussed for the treatment of municipal and industrial waste waters and for nitrification. Trickling filters, supporting a biological slime on rocks, wooden slats, plastic sheets, or other support media, are utilized for treating municipal effluent, industrial wastes, and ammonia concentrations and have led to the development of other packed bed reactors for both aerobic and anaerobic treatment. The types of reactors include fixed bed upflow reactors containing porous media of various sizes exhibiting minor pressure gradients; expanded bed upflow reactors demonstrating a constant pressure gradient; and fixed bed downflow or upflow reactors with increasing pressure gradients which require backwashing or flushing. Rotating biological contractors have eliminated problems common to trickling filters and other fixed beds and have been utilized in the treatment of industrial waste waters and the denitrification of municipal waste waters. The principles, design fundamentals, and design considerations are described for fixed film reactors, expanded or fluidized bed reactors, and rotating biological contractors. Applications and performance efficiencies of fixed film and suspended growth systems were compared. (See also W79-07842) (Lisk-FRC)

W79-07842

F. A. Tonelli, and A. K. W. Ho.
In: Proceedings of the Seminar on Current Approaches in Wastewater Treatment, April 5, 1978, Ontario Ministry of Health Laboratories, Toronto, Canada, p 117-138. (1978) 2 fig. 4 tab. 17 ref.

Chlorine and disinfectant alternatives were evaluated for effectiveness, use-cost, practicality, and potential adverse effects. The disinfectants investigated include chlorine, chlorine dioxide, ozone, bromine chloride, and ultraviolet radiation. Effectiveness was evaluated as the disinfectant's ability to reduce total and fecal coliforms, to inactivate viruses, and to eliminate other pathogenic bacteria. Use-costs were considered as capital costs, amortization costs, operating and maintenance costs, and costs of special waste water pretreatment. Practicality evaluations considered factors of transport, storage, on-site generation, application, control, disinfection predictions, and safety. Desirable properties of chemical disinfectants were considered to be: chemical weakness, predictable chemistry in waste water, readable solubility, and non-toxic or fast-decaying residual; desirable radiation properties include chemical weakness and adequate penetrating power. Potential adverse effects of the disinfected waste water on the receiving waters are considered as toxicity to aquatic life, the formation and transmission of undesirable bio-accumulating substances, and the formation and transmission of toxic, mutagenic, or carcinogenic substances. Results of the evaluation indicated that no single, widely applicable alternative to chlorine disinfection had been demonstrated. Ozone was considered the best developed alternative, but its cost is high and it has limited applicability. Dechlorination was considered feasible for reducing the toxic effects of chlorine. (See also W79-07842) (Lisk-FRC)

W79-07848

Descriptors: *Industrial wastes, *Sewage disposal, *Waste water treatment, *Separation techniques, Oil industry, Heavy metals, Pesticide residues.

The proceedings of the 23rd Ontario Industrial Waste Conference contains 19 papers on the disposal and treatment of industrial wastes. Topics include the control of hydrocarbon sulfide emissions from a heavy oil refinery, plant control of air and water levels discharged into municipal sewers, and solid/liquid separation techniques. A refinery waste water treatment system, pollution abatement at a starch plant, waste water treatment at a General Motors plant, and control of PCBs are discussed. The role of the Ministry of the Environment in the disposal of liquid industrial waste is summarized. (See W79-07830 thru W79-07857) (Small-FRC) W79-07849

Ontario Ministry of the Environment, Toronto.
Wastewater Treatment Section.
S. A. Black.

In: Proceedings of the 23rd Ontario Industrial Waste Conference, held June 13-16, 1976, Toronto, Ontario, p 155-178. (1976) 7 tab. 25 ref.

Descriptors: *Heavy metals, *Industrial wastes, *Municipal wastes, *Ultimate disposal, Regulation, Sewage treatment, Toxicity, Sludge disposal.

THE CONTROL OF HYDROGEN SULPHIDE EMISSIONS AT ONTARIO HYDRO'S BRUCE HEAVY WATER PLANT.

Bruce Heavy Water Plant Ontario Hydro, Tiverton.
S. A. C. Franklin.
In: Proceedings of the 23rd Ontario Industrial Waste Conference, held June 13-16, 1976, Toronto, Ontario, p 70-103, (1976), 23 fig.

Descriptors: *Hydrogen sulfide, *Separation techniques, *Monitoring, *Industrial wastes, Waste water treatment, Water pollution sources, Lake Huron.

Air and water hydrogen sulfide emissions are controlled at Ontario Hydro's Bruce Heavy Water Plant A which uses hydrogen sulfide to extract deuterium from natural water. All water streams containing H₂S are stripped before returning the water to Lake Huron. The strippers discharge their effluent into a common line which can be diverted to lagoons. The effluent stripper process parameters including feed temperature, level, and pressure were interlocked to automatically divert the effluent to lagoons if the measured variables exceeded defined limits. Also, an H₂S monitor was installed which prevents any sour water from entering the lake. Operator training was found to be an essential part of pollution control. (See also W79-07849) (Small-FRC)

Control and Metering Ltd., Toronto (Ontario).
R. Verstraete.

In: Proceedings of the 23rd Ontario Industrial Waste Conference, held June 13-16, 1976, Toronto, Ontario, p 179-201. (1976) 8 fig, 1 tab, 10 ref.

Descriptors: *Separation techniques, *Filters, *Costs, *Performance, *Sludge treatment, Dewatering, Sedimentation, Industrial wastes.

The principle of operation of the inclined plate clarifier is reviewed, and operating experience in Ontario is discussed for the inclined plate separator and filter press. The inclined plate clarifier is efficient, easy to operate, requires reduced floor space, has no moving parts, and has low capital costs. It requires as little as 10% of the floor space of conventional clarifiers and installed costs are less than 50% of conventional clarifiers. The recessed plate filter press is a sludge dewatering device. The solids from the sludge are retained within the filter media to form a low volume dry cake of 30-60% solids while producing a clear filtrate. Filter presses have high efficiency, low energy consumption, and low manpower requirements. (See also W79-07849) (Small-FRC)

In: Proceedings of the 23rd Ontario Industrial Waste Conference, held June 13-16, 1976. Toronto, Ontario, p 202-230. (1976) 7 fig, 4 tab.

Descriptors: *Oil industry, *Waste water treatment, *Filtration, *Design, *Pilot plants, Regulation, Sewerage, Suspended solids, Industrial wastes.

A program to upgrade the waste water treatment capability at Imperial Oil Enterprises, Ltd.'s Sarnia Refinery initiated in 1970 is described. It included a comprehensive program to segregate sewer systems with a view toward minimizing the volume of contaminated water requiring further treatment. Also, a dual media gravity flow filtration system was installed for secondary removal of oil and suspended solids. An activated sludge plant was

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The pollution of a creek at one site was divided into St. Lawrence BOD readings at IV's streams. A lagoon was merged with waste treatment retention time 90% reduction and 60-75%. The total reduction of River. (See 1970-1972)

**WASTEWATER
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W79-07855

THE ROLE OF THE ENVIRONMENTAL INDUSTRY IN ONTARIO
Ontario M. (Ontario). In: E. W. Turner. In: Proceedings of the Waste Conference, Toronto, p. 409.

Waste Treatment Processes—Group 5D

installed to remove a substantial portion of the dissolved organics from the refinery effluent. Developmental and pilot studies are discussed along with the design details of the system. Operating experience is reported and compared to predicted performance. The treatment system has provided the refinery with a system entailing the best practicable technology and which has the capability to meet all Provincial and Federal guidelines. (See also W79-07849) (Small-FRC) W79-07853

POLLUTION ABATEMENT AT CANADA STARCH - A CASE STUDY,

Canada Starch Co. Ltd., Cardinal (Ontario). G. N. Fulford.

In: Proceedings of the 23rd Ontario Industrial Waste Conference, held June 13-16, 1976, Toronto, Ontario, p 231-264. (1976) 8 fig, 4 tab, 16 ref.

Descriptors: *Industrial wastes, *Biochemical oxygen demand, *Monitoring, *Aerobic treatment, Aeration, Waste water treatment, Water pollution sources.

The pollution problems associated with the operation of a corn wet milling plant and their solution at one site are discussed. The effluent streams were divided into those acceptable for discharge into the St. Lawrence River and into a single stream with BOD readings of up to 3000 ppm. Technicon Monitor IV's were used to monitor the acceptable streams. A single cell aerobic facultative or aerated lagoon was used to treat the high BOD waste. The lagoon was constructed by converting an old submerged canal in the St. Lawrence Seaway into a waste treatment plant with approximately 30 days retention time. The plant has operated with an 85-90% reduction of BOD during the summer months and 60-75% reduction during the colder months. The total program is responsible for an overall reduction of 85-90% in BOD to the St. Lawrence River. (See also W79-07849) (Small-FRC) W79-07854

WASTEWATER TREATMENT AND OIL RECLAMATION AT GENERAL MOTORS, ST. CATHERINES,

General Motors of Canada Ltd., St. Catharines (Ontario).

R. E. Johnson, Jr.

In: Proceedings of the 23rd Ontario Industrial Waste Conference, held June 13-16, 1976, Toronto, Ontario, p 345-357. (1976) 2 fig, 2 tab.

Descriptors: *Oily water, *Reclamation, *Recycling, *Waste water treatment, Separation techniques, Regulation, Costs, Industrial wastes.

The operation of the Liquid Waste Treatment Plant located at the Axle Plant in St. Catharines, Ontario, is described. The plant treats over 270,000 gallons of liquid waste per day which consist of various oils, greases, washing chemicals, and process waters. The treatment plant separates petroleum products from the water phase via the acid-soluble process. It removes pollutants from the water in compliance with Regional and Provincial laws. Also, it removes contaminants present in the separated oils and reclaims or recycles the oil back to the manufacturing plants. The chemically treated water is discharged to city sewers. Over 225,000 gallons of soluble oil concentrate and 100,000 gallons of cutting oil are produced annually at this plant at economical prices. Current experiments are described on the feasibility of formulating hydraulic oil from GM reclaimed oil. (See also W79-07849) (Small-FRC) W79-07855

THE ROLE OF THE MINISTRY OF THE ENVIRONMENT IN THE DISPOSAL OF LIQUID INDUSTRIAL WASTE IN ONTARIO,

Ontario Ministry of the Environment, Toronto (Ontario). Pollution Control Branch.

E. W. Turner, and W. J. Hogg.

In: Proceedings of the 23rd Ontario Industrial Waste Conference, June 13-16, 1976, Toronto, Ontario, p 409-448. (1976) 6 tab.

Descriptors: *Waste disposal, *Industrial wastes, *Regulation, *Liquid wastes, Canada, Reclamation, Incineration, Landfills, Waste disposal wells, Ultimate disposal.

Actions by the Ministry of the Environment to control the problem of the disposal of liquid industrial wastes are reviewed including the way-bill system. The types and volumes of liquid wastes generated in Canada are tabulated. Using the way-bill system, the two parties to a disposal or transfer of liquid industrial waste are required to report independently to the Ministry. A voluntary way-bill system indicated that significant gains in the control and disposal of liquid industrial wastes could be achieved by making a regulation to document and control the movement of all liquid industrial wastes. Waste treatment and disposal technology is reviewed including: reclamation and/or recovery, re-use, incineration, incineration in cement kilns, deep-well disposal, solidification, landfilling, and treatment. (See also W79-07849) (Small-FRC) W79-07856

PROCEEDINGS OF THE TWENTY-FIFTH SILVER ANNIVERSARY OF THE ONTARIO INDUSTRIAL WASTE CONFERENCE.

Held June 18-21, 1978 at Toronto, Ontario, (1978). 390 p. Ministry of the Environment, Ontario.

Descriptors: *Industrial wastes, *Pollution abatement, Filtration, Trickling filters, Dewatering, Creosote, Mining industry.

Twenty papers were presented at this conference on industrial waste abatement. Waste water treatment topics included ultrafiltration of oily water, a trickling filter for pretreatment of vegetable wastes, solidification of liquid industrial wastes, prevention of creosote contamination of groundwater, and the environmental controls practiced by Ontario's mining industry. 500 delegates attended the meetings. (See W79-07859 thru W79-07863) (Small-FRC) W79-07858

MINING AND THE ENVIRONMENT - A QUARTER CENTURY IN REVIEW,

Ontario Mining Association, Toronto.

W. C. Ferguson.

In: Proceedings of the twenty-fifth Silver Anniversary of the Ontario Industrial Waste Conference, held June 18-21, 1978, Toronto, Ontario, p 2-21. (1978).

Descriptors: *Mineral industry, *Mining, *Mine water, *Mine wastes, Recycling, Waste water treatment, Heavy metals, Canada.

The environmental achievements of Ontario's mining industry are reviewed. More than 60 minerals are produced in about 300 operating mines in Canada; Ontario produces 40% or more than \$2 billion in minerals each year. The three effluent disposal problems associated with mining are mine-water, tailings, and waste rock. Of the 193 million gallons of water per day used in Ontario mines, 111 million gallons are recycled. Treatment processes have reduced the heavy metals including copper, nickel, lead, and zinc discharged by the 53 active mines in Ontario to less than 1000 pounds per day. Reclamation and revegetation efforts are also reviewed. (See also W79-07858) (Small-FRC) W79-07859

HYDROGEOLOGICAL CONTROL AND CLEAN-UP OF SOIL AND GROUNDWATER CONTAMINANTS AT NORTHERN WOOD PRESERVES, LTD.,

G. E. Thompson.

In: Proceedings of the Twenty-fifth Silver Anniversary, Ontario Industrial Waste Conference, held June 18-21, 1978, Toronto, Ontario, p 250-268. (1978) 12 fig.

Descriptors: *Chemical industry, *Creosote, *Lake Superior, *Phenols, *Water quality control, Landfill, Runoff, Pilot plants, Activated carbon, Waste water treatment, Ozon.

Methods to prevent creosote contamination of Lake Superior by the Northern Wood Preservers, Ltd. plant in Thunder Bay are described. At the plant, wood products are treated with creosote, chromated copper arsenate, and pentachlorophenol. Some spilled creosote was washed directly into the lake by runoff, and the major portion infiltrated the landfill and moved laterally into the lake. The lake water had a high phenol content and creosote accumulated on the bottom. Northern Wood dredged the lake to remove the accumulated creosote. An investigation of the site led to the recommendation that well points be installed to prevent the movement of creosote to the lake. Pilot studies were conducted on the effluent which concluded that the most appropriate treatment for the effluent is ozonation or activated carbon. Two alternative treatment systems investigated consisted of an API separator, ozonation system, and gravity sand filter, or an API separator and a battery of activated carbon columns. (See also W79-07858) (Small-FRC) W79-07860

PRETREATMENT OF VEGETABLE WASTEWATER AT THE H. J. HEINZ PLANT IN LEAMINGTON, ONTARIO,

Heinz (H. J.) Co. of Canada Ltd., Leamington (Ontario). Quality Assurance Dept.

D. Smit, and T. E. Eyre.

In: Proceedings of the Twenty-fifth Silver Anniversary of the Ontario Industrial Waste Conference, held June 18-21, 1978, Toronto, Ontario, p 269-275. (1978) 1 fig.

Descriptors: *Food processing industry, *Waste water treatment, *Trickling filters, *Packed beds, Aeration, Landfills, Biochemical oxygen demand.

Use of a roughing plastic media tower for the pretreatment of vegetable waste water is discussed. The waste water treatment plant consists of screening facilities, a 4 million gallon aeration basin with four 75 HP aerators and one 150 HP aerator, and a 1 million gallon circular clarifier. Sludge is concentrated and removed to a landfill. The tower was constructed to lower BOD during peak operations. It was constructed out of plastic media to a height of 12 ft, with an overall size of 32 x 32 ft. The total waste flow in the plant is kept below 3 million Imperial gallons per day and 25% of the flow is pretreated in the tower. With the new system, COD removal was only about 20% due to scouring by sand caused by machine-picked crops. A settling basin is being installed to remove the sand. More pretreatment towers are planned at this plant. (See also W79-07858) (Small-FRC) W79-07861

TREATMENT AND RECOVERY OF EMULSIFIED OIL BY ULTRAFILTRATION,

Electrohome Ltd., Kitchener (Ontario).

G. Dhawan.

In: Proceedings of the Twenty Fifth Silver Anniversary of the Ontario Industrial Waste Conference, held June 18-21, 1978, Toronto, Ontario, p 276-291, 1978. 8 fig.

Descriptors: *Filtration, *Oily water, *Recycling, *Separation techniques, Waste water treatment, Costs, Emulsifiers.

An ultrafiltration plant is described which was developed by Electrohome Ltd., and which has been operating at Budd Automotive, Kitchener, Ontario, since 1976. The plant treats oil water from washers, and the oil concentration varies from 0-5%. The ultrafiltration system removes oil continuously and maintains a washer oil concentration under 5%. After settling, the concentrated oil has a final oil concentration of 70-90%. The water from the ultrafiltration system contains most of the emulsifiers used in the washers and it is recycled to the washers. A payback of less than two years is realized by savings in oil, elimination of waste disposal costs, and reduction in the washer clean-up. (See also W79-07858) (Small-FRC) W79-07862

SOLIDIFICATION OF WASTES,

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

D. Kroschak.

In: Proceedings of the Twenty-fifth Silver Anniversary, Ontario Industrial Waste Conference, held June 18-21, 1978, Toronto, Ontario, p 378-390. (1978) 6 fig, 1 tab, 4 ref.

Descriptors: *Waste disposal, *Industrial wastes, *Landfills, *Leachate, *Dewatering, Heavy metals, Water pollution sources.

Solidification of wastes was evaluated on liquid wastes from various industrial sources. Industrial wastes were unloaded into either of two 125,000 gallon holding lagoons. A third 100,000 lagoon was used to blend waste prior to solidification treatment. Solidification was performed in 3500 gallon batches. Alkaline and silicate reagents were added to the waste in a blender, and the resulting slurry was fed to the reaction tank. The solidified product was cured for several days and then removed to a landfill. The stability of 10 solidified samples was evaluated with respect to environmental attack by aqueous solutions in a series of 25 leaching tests. Column leaching flow tests were run for 8-26 days while constant volume leaching tests were run for 9-13 days. Concentration of heavy metals was generally less than 1 ppm for individual metals. These elements include Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Ti, V, and Zn. (See also W79-07858) (Small-FRC) W79-07863

CONFERENCE ON MUSKEGON COUNTY, MICHIGAN WASTEWATER SYSTEM, SEPTEMBER 17-18, 1975, A CRITICAL REVIEW ON EVALUATIONS OF THE SYSTEM AND IDENTIFICATION OF NEEDED RESEARCH. Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 552. Price codes: A09 in paper copy, A01 in microfiche. Report EPA-905/9-76-006, 1976. 178 p.

Descriptors: *Irrigation systems, *Experimental farms, *Performance, *Waste water treatment, Municipal wastes, Industrial wastes, Design, Costs, Agricultural engineering, Michigan.

The Muskegon County waste water treatment system was reviewed and evaluated. The operation of the municipal-industrial collection system, an aeration system, holding lagoons, and a spray irrigation system are discussed. Progress is outlined from 1969 through 1975. Topics discussed include agricultural engineering, agricultural management of waste water utilization, soil monitoring, and modeling and economic studies. Participants included principal investigators and government representatives. (See W79-07865 and W79-07866) (Small-FRC) W79-07864

REVIEW OF SYSTEM DESIGN PARAMETERS. Bauer (W. J.) Consulting Engineers, Chicago, IL. W. J. Bauer.

In: Conference on Muskegon County, Michigan Wastewater System, September 17-18, 1975, A Critical Review on Evaluations of the System and Identification of Needed Research, p 44-55. 1976.

Descriptors: *Irrigation systems, *Experimental farms, *Design, *Performance, Land clearing, Municipal wastes, Waste water treatment, Costs, Biochemical oxygen demand, Michigan.

The Muskegon County waste water irrigation project experiences during startup are described and related to the original design considerations. The flow was estimated to average 28.5 MGD which was very near the actual flow. BOD is somewhat less than that assumed in the design resulting in less demand than expected for aeration. Problems were encountered with failures in insulation of buried electrical cables, with failures of asbestos cement pressure pipes, and with clogging of nozzles with vegetation and sand. Most of the problems were caused by substandard workmanship, although some are related to design criteria. Problems were also encountered with the clearing of trees, because air pollution regulations made burning of the cleared trees impossible. The water quality objectives of the system were accom-

plished. In 1975, operating costs were forecast to be \$1.4 million to be offset by a crop sales revenue of about \$1 million. The net cost per gallon treated would then be \$40 per million gallon. (See also W79-07864) (Small-FRC) W79-07865

PERFORMANCE AND ECONOMICS OF THE SYSTEM. Muskegon County Wastewater Management System, MI. Y. A. Demirian.

In: Conference on Muskegon County, Michigan Wastewater System, September 17-18, 1975, A Critical Review on Evaluations of the System and Identification of Needed Research, p 56-72. 1976 3 fig, 11 tab.

Descriptors: *Irrigation systems, *Experimental farms, *Biochemical oxygen demand, *Nitrogen, *Performance, Phosphate, Coliforms, Costs, Municipal wastes, Waste water treatment, Michigan.

The Muskegon, Michigan waste water treatment system which utilizes land application at an 11,000 acre site, is evaluated. The system reduces BOD over 98% and COD drops from 550 ppm to 30-40 ppm. This reduction occurs during storage and aeration. Total nitrogen is reduced from 15 ppm to 2.5 ppm, and phosphate is reduced by 97%. The systems meets NPDES discharge limits except for fecal coliform. This is thought to be due to contamination by waterfowl. Actual costs for aeration were \$216,000, for storage were \$62,000, and for irrigation were \$250,000 per year. Problems were encountered with sand and vegetation clogging of irrigation nozzles. A sump will be added to remove sand and screens will be used to eliminate vegetation and other debris. The crop yield in 1975 was double 1974 levels. (See also W79-07864) (Small-FRC) W79-07866

SCREENING/FLOTATION TREATMENT OF COMBINED SEWER OVERFLOWS. VOLUME I - BENCH SCALE AND PILOT PLANT INVESTIGATIONS. Envirex, Inc., Milwaukee, WI.

M. K. Gupta, D. G. Mason, M. J. Clark, T. L. Meinholz, and C. A. Hansen.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 834. Price codes: A13 in paper copy, A01 in microfiche. Report EPA-600/2-77-069a, 1977. 295 p, 38 fig, 117 tab, 71 ref, 6 append.

Descriptors: *Screens, *Flotation, *Combined sewers, *Overflow, Outfall sewers, *Pilot plants, Suspended solids, Biochemical oxygen demand, Chemical oxygen demand, Waste water treatment, Municipal wastes.

The treatment of combined sewer overflows by a combined screening and dissolved-air flotation system was evaluated in laboratory tests and in two 5 mgd pilot plants. Laboratory tests evaluated chemical oxidation, screening, dissolved-air flotation, and disinfection as treatments for combined sewer overflows containing particulate pollutants; chemical oxidation was not considered feasible. A pilot screening and dissolved-air flotation facility incorporating one drum screen was established at an outfall and handled a total of 63 combined sewer overflows. The pilot plant achieved BOD, COD, and suspended solids removals in the range of 60-75%. Another sequential screening plant with three drum screens in series was also operated at the outfall and accommodated 21 combined sewer overflows. The plant achieved about 30% reduction of suspended solids, volatile suspended solids, BOD, COD, and total organic carbon. No significant improvements in removal efficiencies were observed when chemical flocculants were added or when the hydraulic and solids loadings varied. No significant improvements were obtained in the screening/flotation plant when it was operated in an effluent flow pressurization mode or with powdered activated carbon. Removal efficiency was improved by 5-10% when the effluent was polished with 22 micron microscreening. (Lisk-FRC) W79-07867

MANUAL FOR THE CONTROL OF HAZARDOUS MATERIAL SPILLS. VOLUME ONE. SPILL ASSESSMENT AND WATER TREATMENT TECHNIQUES.

Envirex, Inc., Milwaukee, WI. Environmental Sciences Div. For primary bibliographic entry see Field 5B. W79-07868

SEPARATION OF ALGAL CELLS FROM WASTEWATER LAGOON EFFLUENTS, VOL. III: SOIL MANTLE TREATMENT OF WASTEWATER STABILIZATION POND EFFLUENT - SPRINKLER IRRIGATION. Utah Water Research Lab., Logan.

B. T. Hicken, R. S. Tinkey, R. A. Gearheart, J. H. Reynolds, and D. S. Filip. Available from the National Technical Information Service, Springfield, VA 22161 as PB-292 537. Price codes: A11 in paper copy, A01 in microfiche. Report EPA-600/2-78-097, 1978. 233 p, 33 fig, 30 tab, 100 ref, 3 append.

Descriptors: *Waste water treatment, *Land use, *Irrigation practices, *On-site investigations, *Performance, Lysimeters, Leaching, Suspended solids, Nitrates, Phosphorus, Ammonia, Application methods, Coliforms, Utah.

The efficiency of sprinkler irrigation wastewater treatment was evaluated by lysimeter studies and a two-year field study as a means of polishing waste water stabilization lagoon effluent. In the lysimeter study, four Utah soils were evaluated for their effectiveness in removing total coliform and fecal streptococcal organisms as well as nitrogen, phosphorus, and carbon compounds. The removal efficiencies for carbon, nitrogen, and phosphorus compounds were evaluated in field experiments. All four soils were found to be effective in removing three indicator organisms, organic compounds, and suspended solids. Leaching of salts from soils occurred during the field experiments on a drainage farm. The characteristics of the drainage farm system appeared to control the quality of the effluent. Superior quality is expected once equilibrium is established. In the field experiments, phosphorus removal exceeded 80%. The rate of waste water application made no significant difference in the phosphorus removal rate. There was evidence of nitrate leaching from the soil. Ammonia stripping removed about 35% of the ammonia when the lagoon effluent was sprayed on the land. Excellent suspended solids removal was effected by the soil mantle treatment system. The suspended solids concentrations in the drainage water from a 1.2 m deep mole drain contained an average suspended solids concentration of 2 mg/liter. (Small-FRC) W79-07870

DESTROYING CHEMICAL WASTES IN COMMERCIAL SCALE INCINERATORS. FACILITY REPORT NUMBER 3 - SYSTEMS TECHNOLOGY.

TRW Defense and Space Systems Group, Redondo Beach, CA.

D. G. Ackerman, J. F. Clausen, R. J. Johnson, and C. A. Zeck.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-265 540. Price codes: A05 in paper copy, A01 in microfiche. Report, 1977. 96 p, 13 fig, 39 tab, 4 ref, 4 append.

Descriptors: *Chemical wastes, *Phenols, *Incineration, *Ultimate disposal, *Aqueous solutions, Cost analysis, Capital costs, Operating costs, Industrial wastes, Waste water treatment.

The incineration of two liquid industrial waste streams in a fluidized bed incinerator was evaluated. The waste streams were an aqueous phenol sludge and an aqueous solution of methyl methacrylate monomer. The effects of operating and equipment variables were determined by performing the incineration tests at two different flow rates. The process achieved a destruction efficiency of more than 99.999% of each waste material, as indicated by the analysis of combustion gas samples. No organics could be detected in the scrubber water or ash and stack emissions were analyzed for particulate loading and composition.

A capital cost of \$255/metric ton (13.2 million lb) incinerator phenol waste. Incineration capital investment cost. (Lisk-FRC) W79-07871

DESTROYING CHEMICAL WASTES IN COMMERCIAL SCALE INCINERATORS. FACILITY REPORT NUMBER 3 - SYSTEMS TECHNOLOGY. TRW Defense and Space Systems Group, Redondo Beach, CA. J. F. Clausen, R. J. Johnson, and C. A. Zeck. Available from the National Technical Information Service, Springfield, VA 22161 as PB-265 540. Price codes: A05 in paper copy, A01 in microfiche. Report, 1977. 96 p, 13 fig, 39 tab, 4 ref, 4 append.

Descriptors: *Waste water treatment, *Land use, *Irrigation practices, *On-site investigations, *Performance, Lysimeters, Leaching, Suspended solids, Nitrates, Phosphorus, Ammonia, Application methods, Coliforms, Utah.

The incineration of two liquid industrial waste streams in a fluidized bed incinerator was evaluated. The waste streams were an aqueous phenol sludge and an aqueous solution of methyl methacrylate monomer. The effects of operating and equipment variables were determined by performing the incineration tests at two different flow rates. The process achieved a destruction efficiency of more than 99.999% of each waste material, as indicated by the analysis of combustion gas samples. No organics could be detected in the scrubber water or ash and stack emissions were analyzed for particulate loading and composition. (Lisk-FRC) W79-07872

PHYSICAL TREATMENT OF WASTE WATER. Little (Arthur B.) Berkov. Available from the National Technical Information Service, Springfield, VA 22161 as PB-265 540. Price codes: A05 in paper copy, A01 in microfiche. Report, 1977. 96 p, 13 fig, 39 tab, 4 ref, 4 append.

Descriptors: *Evaluation, *Adsorption, *Dialysis, *Tolysis, *Water treatment.

The suitability of the treatment investigated already in use and development attractive. The data on the economics, operations, and wastes are in this volume. The logical treatment, chlorination, electrocoagulation, and drying, and treatment (Lisk-FRC) W79-07873

Ultimate Disposal Of Wastes—Group 5E

A capital cost of \$6 million and an operating cost of \$255/metric ton were estimated for destroying 13.2 million liters/yr of aqueous methyl methacrylate. Incineration of 23.8 million liters/yr of aqueous phenol waste would cost an estimated \$6 million capital investment and \$124/metric ton operating cost. (Lisk-FRC)
W79-07871

DESTROYING CHEMICAL WASTES IN COMMERCIAL SCALE INCINERATORS. FACILITY REPORT NUMBER 1 - THE MARQUARDT COMPANY,

TRW Defense and Space Systems Group, Redondo Beach, CA.
J. F. Clausen, R. J. Johnson, and C. A. Zee.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-265 541. Price codes: A06 in paper copy, A01 in microfiche. Report, 1977. 127 p, 27 fig, 39 tab, 4 append.

Descriptors: *Chemical wastes, *Incineration, *Ultimate disposal, *Aqueous solutions, *Effluent streams, Cost analysis, Capital costs, Operating costs, Waste water treatment, Industrial wastes.

The incineration of two liquid industrial waste streams, ethylene manufacturing waste and hexachlorocyclopentadiene (C-5,6) was investigated. The ethylene wastes were combusted at three different temperatures while the C-5,6 wastes, which required auxiliary fuel for incineration, were burned at three different fuel/waste ratios to determine the effects of normal operating and equipment variables. Destruction efficiencies of more than 99.999% were achieved for each waste constituent. No increase in organics was detected in the scrubber water. Particulate loading and composition of the stack emissions were analyzed with Standard EPA Method 5 tests. No chlorinated organics were found in the burner head residue formed during incineration of the wastes. Liquid injection incineration of the wastes was considered effective, but rotary kiln incineration was considered more suitable for C-5,6 waste because of tarry residual. A capital cost of \$1.8 million and an annual operating cost of \$1.0 million were estimated for the destruction of an annual load of 15 million kg of ethylene waste. Incineration of 4.5 million kg/yr of C-5,6 would cost an estimated \$1.6 million capital investment and \$2.2 million/yr operating costs. (Lisk-FRC)
W79-07872

PHYSICAL, CHEMICAL, AND BIOLOGICAL TREATMENT TECHNIQUES FOR INDUSTRIAL WASTES. VOLUME 1,

Little (Arthur D.), Inc., Cambridge, MA.

J. B. Berkowitz.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-275 054. Price codes: A21 in paper copy, A01 in microfiche. Report, 1977. 474 p, 56 fig, 76 tab, 406 ref.

Descriptors: *Treatment, *Industrial wastes, *Evaluation, *Performance, *Biological treatment, Adsorption, Catalysts, Centrifugation, Chlorination, Dialysis, Distillation, Electrodialysis, Electrolysis, Electrophoresis, Freeze drying, Waste water treatment.

The suitability of 47 unit engineering processes in the treatment of hazardous industrial wastes was investigated. Some of the treatment processes are already in use while others require further research and development before they will be commercially attractive. Descriptions of the unit processes and data on their basic principles, areas of application, economics, energy and environmental considerations, and the future outlook for use on industrial wastes are provided. The treatment processes in this volume include 2 adsorption processes, 7 biological treatments, calcination, catalysis, centrifugation, chlorinolysis, dialysis, dissolution, distillation, electrodialysis, electrolysis, and electrophoresis. Process evaluations are continued in Volume II of the report. Dialysis, electrophoresis, freeze drying, and zone refining were not suitable for the treatment of hazardous industrial wastes. (Lisk-FRC)
W79-07873

HIGHLIGHTS OF THE CLEAN WATER ACT OF 1977,

M. P. Kerner.

Environmental Law, Vol. 8, No. 2, p 869-85, 1978.

Descriptors: *Federal water pollution control act, *Federal government, *Water pollution, Dredging, Oil spills, Industries, Waste water treatment, Taxes, Sewage treatment, Industrial wastes.

Amendments to the 1972 Federal Water Pollution Control Act Amendments (FWPCA), passed by Congress on December 15, 1977, were signed by President Carter on December 28, 1977. The amendments change the name of the FWPCA to the 'Clean Water Act' and reconcile the conflicting provisions of the House and Senate bills. The amendments are basically revisional, allowing for some flexibility in meeting various requirements and time limits of the FWPCA. Those areas where deadlines have been extended are identified: (1) 1977 'Best Practicable Control Technology Currently Available' deadline extensions for industrial dischargers; (2) 1977 secondary treatment deadline extensions for municipal waste treatment facilities; and (3) 1983 'Best Available Technology Economically Achievable' deadline extension for industrial dischargers. Also identified and discussed are new provisions in the following areas: (1) Army Corps of Engineers jurisdiction over dredge and fill materials; (2) Federal facility compliance; (3) oil spill liability; (4) best management practices for industry; (5) irrigation return flows; (6) secondary treatment requirements for municipal waste treatment dischargers; (7) funding authorization for existing sewer system rehabilitation; (8) federal funding for individual waste treatment facilities; (9) ad valorem taxes; and (10) alternative waste treatment. (Vloedman-Florida)
W79-07874

LAND APPLICATION OF WASTEWATER AND STATE WATER LAW: STATE ANALYSES VOLUME II,

Wisconsin Univ.-Madison. School of Law.

For primary bibliographic entry see Field 6E.

W79-07876

FLOOD PLAIN DEVELOPMENT PRESSURES AND FEDERAL PROGRAMS-PART I-CASE STUDY ANALYSIS AND RECOMMENDATIONS FOR THE '201' WASTEWATER TREATMENT WORKS PROGRAM,

Research Group, Inc., Atlanta, GA.

For primary bibliographic entry see Field 6E.

W79-07877

THE ECONOMIC IMPACT OF ALTERNATIVE CYANIDE STANDARDS IN ILLINOIS,

IIT Research Inst., Chicago, IL.

For primary bibliographic entry see Field 6E.

W79-07885

CONSERVATION DISTRICTS AND 208 WATER QUALITY MANAGEMENT-NON-POINT SOURCE IDENTIFICATION AND ASSESSMENT, SELECTION OF BEST MANAGEMENT PRACTICES, MANAGEMENT AGENCIES, REGULATORY PROGRAMS,

National Association of Conservation Districts, Washington, DC.

For primary bibliographic entry see Field 4A.

W79-07886

GROUND AND SURFACE WATER IN NEW MEXICO: ARE THEY PROTECTED AGAINST URANIUM MINING AND MILLING,

For primary bibliographic entry see Field 6E.

W79-07896

THE RISING COSTS OF MINE DRAINAGE ABATEMENT,

Maryland Dept. of Natural Resources, Annapolis. Energy and Coastal Zone Administration.

A. F. Abar.

In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a

Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978, p 109-111. Interstate Commission on the Potomac River Basin, Rockville, Md. Technical Publication 78-2.

Descriptors: *Coal mine wastes, *Mine drainage, *Acid mine water, *Water pollution sources, *Pollution abatement, *Costs, Capital costs, Estimates costs, Water pollution treatment, Abatement, Water quality control, Water purification, Georges Creek River basin project (Maryland).

Acid mine drainage (AMD) continuously impacts about 4,275 miles of the Susquehanna, Allegheny, Delaware, Monongahela, and Potomac River basins. In considering abatement program costs, statistics concerning mine drainage sources are more important than those concerning the extent of AMD. Abandoned mines produce 80% of all AMD in the Appalachian Region, and more than 80% of the AMD from all abandoned mines is produced by deep abandoned mines. The solutions and costs are complex, and demonstrate the need for a publicly funded AMD pollution abatement program. According to a 1969 study conducted by the Appalachian Regional Commission, the capital costs of controlling AMD are estimated at \$6.6 billion. Abatement program costs are incurred before project construction is actually initiated, because field reconnaissance is necessary to locate AMD sources from deep abandoned mines. The Georges Creek River basin project in Allegheny and Garrett Counties in Maryland is discussed as an example of the complexity of the abatement program. Techniques developed to eliminate or reduce AMD are generally preventive measures to inhibit AMD formation, or treatment measures which capture and treat AMD after its formation and discharge from the mine. Current mining operations are eliminating many abandoned mine problems by mining and reclaiming adjacent areas; this includes daylighting deep mines and reclamation of surface-mined land. Recent legislation passed in Maryland imposes a 15 cent per ton surcharge on all coal mined in the State, which provides a cash flow to cover recurring costs. (Davison-IPA)
W79-07977

IMPACT OF WASTEWATER TREATMENT PLANT DISCHARGES,

Maryland Univ., College Park. Inland Environmental Lab.

For primary bibliographic entry see Field 5C.

W79-07985

5E. Ultimate Disposal Of Wastes

LONG-TERM EFFECTS OF LAND APPLICATION OF DOMESTIC WASTEWATER: HOLLISTER, CALIFORNIA, RAPID INFILTRATION SITE,

Metcalf and Eddy, Inc., Palo Alto, CA.

C. E. Pound, R. W. Crites, and J. V. Olson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-283 405. Price codes: A08 in paper copy, A01 in microfiche. Report No. EPA-600/2-78-084, April 1978. 166 p, 42 fig, 64 tab, 96 ref, 3 append. 68-03-2361.

Descriptors: *Waste water disposal, *Infiltration, *Percolation, Trace elements, Groundwater recharge, Soil chemistry, Flooding, Effluents, Municipal wastes, Liquid wastes, Water table, Infiltration galleries, Settling basins, Hollister (California).

The effects of more than 30 years application of primary treated municipal waste water to a rapid infiltration site were evaluated by analyzing groundwater and soil chemistry at the site. The current daily flow at the Hollister, California, infiltration basins is 43.8 L/s (1.0 M gal/day). The 20 infiltration basins are flooded for one to two days every 14 to 21 days, depending on the size of the basin and the season; annual waste water application equal 15.4 m, or 51 ft/basin. Water table response to the applications was monitored, infiltration rates were determined, and subsurface hydrology was logged. Samples from the one-year analysis program included: (1) primary effluent, (2)

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5E—Ultimate Disposal Of Wastes

on-site and control site soil profiles, (3) groundwater at the site and upgradient and downgradient of groundwater movement from the site. Results of the primary effluent and groundwater analyses indicated that percolation through 22 ft of unsaturated gravelly, sandy loam effectively reduced COD, BOD, TOC, nitrogen, and fecal coliform bacteria. Although effective phosphorus removal required longer travel distances, the soil sorption capacity has not been exceeded. Soil retention of trace elements was low, and only lead exceeded EPA drinking water limits in the waste water and the shallow groundwater aquifer. Slight boron removal in the percolate was observed; iron and manganese are being leached from the soil with the percolating waste water. (Davison-IPA)
W79-07512

ORGANIC COMPOUNDS IN ORGANOPHOSPHORUS PESTICIDE MANUFACTURING WASTEWATERS.
Midwest Research Inst., Kansas City, MO.
M. Marcus, J. Spigarelli, and H. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-289 821. Price codes: A07 in paper copy, A01 in microfiche. Report No. EPA-600/4-78-056, September 1978. 141 p, 55 fig, 22 tab, 9 ref, 2 append. 68-03-2343.

Descriptors: *Organophosphorus pesticides, *Organic pesticides, *Industrial wastes, *Pesticide removal, *Waste water treatment, Waste treatment, Effluents, Water pollution sources, Water pollution, Water quality, Water quality control, Liquid wastes, Organic compounds.

The nature of organophosphorus pesticide manufacturing plant effluents was studied to develop preliminary survey information on the waste water streams of this industry, and to develop analytical methods for monitoring compound levels present in these streams. In addition to identifying and quantifying organophosphorus compounds, non-phosphorus chemicals were included in the survey. Samples of diazinon, methyl parathion, azinphos-methyl and disulfoton, fonofos, phosmet and bensulfide, and EPN were taken at pre-, mid-, and post-treatment locations from five pesticide plants. These samples were analyzed utilizing extraction and partitioning, gas chromatography with specific element detection, thin-layer chromatography, infrared spectroscopy, and gas chromatography/mass spectrometry. Among the 116 compounds identified were: organophosphorus pesticides, related organophosphorus esters, organophosphorus acids, thiocarbamate pesticides, and triazine herbicides. Final effluent levels of organophosphorus pesticides were generally below 0.005 mg/liter, indicating effective removal by the waste treatment systems studied. Oxygen analogs of the pesticides were not a significant degradation product of any of the treatment processes. Organophosphorus acids were only partially removed by the treatment systems, and methyl phosphorothioates actually increased in concentration during treatment, possibly indicative of biomethylation of phosphorothioic acids. (Davison-IPA)
W79-07513

ASSESSMENT OF LOW-GROUND-PRESSURE EQUIPMENT FOR USE IN CONTAINMENT AREA OPERATION AND MAINTENANCE.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
W. E. Willoughby.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A058 501. Price codes: A06 in paper copy, A01 in microfiche. Technical Report DS-78-9, July 1978. 106 p, 11 fig, 3 ref, 2 append.

Descriptors: *Equipment, *Operation and maintenance, *Dredged material disposal, *Containment areas, *Low-ground-pressure equipment, Soft soils.

Guidelines for the selection of equipment to operate in and around confined dredged material disposal areas were developed as part of the Dredged Material Research Program (DMRP). In the early phase of the DMRP, it was recognized that, in order to implement concepts for management of

disposal areas to minimize adverse environmental impacts, equipment must be employed that can operate on very soft soils. In a three-phase study, guidelines were developed (a) compiling a catalog of low-ground-pressure equipment, (b) analytically predicting vehicle performance, and (c) verifying the predictions of the field condition. This report is a synthesis of the three studies. The equipment catalog is included as Appendix A. Guidance for performing required soils tests is contained in Appendix B. (WES)
W79-07520

THE AGRICULTURAL VALUE OF DREDGED MATERIAL.
Science and Education Administration, St. Paul, MN. North Central Region.
S. C. Gupta, W. E. Larson, R. G. Gast, S. M. Combs, and R. H. Dowdy.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A061 298. Price codes: A08 in paper copy, A01 in microfiche. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Technical Report D-78-36, July 1978. 165 p, 44 fig, 26 tab, 74 ref, 3 append.

Descriptors: *Agricultural engineering, Agriculture, *Dredged material, Sediment analysis.

To study the suitability of dredged material for crop production, 10 dredged material samples and 10 marginal soil samples were collected from locations in the United States. The soils were marginal for crop production and were of such character that additions of dredged material might improve their physical and chemical properties. The soils and dredged material samples were dried, ground, and mixed for plant growth studies and laboratory analysis. These treatments were prepared: (a) soil alone; (b) 1/3 soil and 2/3 dredged material; (c) 2/3 soil and 1/3 dredged material; and (d) dredged material alone. Three productive soils were chosen from the St. Paul, Minn., area as controls. Three cuttings of ryegrass and two crops of barley were harvested from each treatment. Greenhouse yields were greater for all fine-textured dredged material samples compared to coarse-grained marginal soils. Results show that the dredged material used in this study may increase agricultural production when mixed with marginal soils. Relationships between uptake and the availability of various soil elements were developed for setting the ratio of dredged material to marginal soil used in the field. Physical and chemical data, along with plant growth data, were used to develop guidelines for disposing dredged material on marginal soils. (WES)
W79-07521

EFFECTS OF SUSPENDED DREDGED MATERIAL ON AQUATIC ANIMALS.
California Univ., Bodega Bay. Bodega Marine Lab.
R. K. Peddicord, and V. A. McFarland.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A058 489. Price codes: A06 in paper copy, A01 in microfiche. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Technical Report D-78-29, July 1978. 115 p, 3 append, 11 tab, 39 fig, 55 ref.

Descriptors: *Aquatic animals, *Suspended load, Sediments, *Dredged material.

Evaluates the impact of suspensions of relatively uncontaminated and contaminated harbor sediments on juvenile and adult marine, estuarine and freshwater fish and invertebrates. Studies of survival and tissue accumulation of contaminants were conducted for 21 days exposure to suspended sediments in a flow-through aquarium system. Even the most sensitive fish survived days of continuous exposure to suspensions of relatively uncontaminated sediment on the order of grams per litre, and the invertebrates generally survived similar exposures to tens of grams per litre of relatively uncontaminated sediment. Exposure to suspensions of contaminated sediment decreased survival substantially, but mortality occurred only after exposure to higher concentrations for longer time periods than are created in the water column by the typical dredging operation. Only fingerling striped

bass *Morone saxatilis* showed a sensitivity great enough to indicate potential cause for concern from continuous pipeline discharge of highly contaminated dredged material. While water column impacts appeared to warrant little concern, data indicate potential for impact of contaminated fluid mud on benthic infauna and relatively immobile epifauna. Fluid muds with suspended sediment concentrations of tens of grams per litre can persist for sufficient periods to have potential impact on immobile bottom dwellers. (WES)
W79-07523

FIELD INVESTIGATIONS OF THE NATURE, DEGREE, AND EXTENT OF TURBIDITY GENERATED BY OPEN-WATER PIPELINE DISPOSAL OPERATIONS.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. R. Schubel, H. H. Carter, R. E. Wilson, W. M. Wise, and M. G. Heaton.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A058 507. Price codes: A14 in paper copy, A01 in microfiche. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Technical Report D-78-30, July 1978. 297 p, 4 append, 130 fig, 37 tab, 66 ref.

Descriptors: *Turbidity, Suspended solids, *Dredged material, *Dredged material disposal, *Open water disposal, Plumes, Environmental effects.

Characteristics of turbidity plumes near open-water pipeline disposal operations are evaluated. Distribution and concentration of dissolved heavy metals, nutrients, and dissolved oxygen also are evaluated. Based on field studies at Corpus Christi Bay, Texas, Atchafalaya Bay, Louisiana, and Apalachicola Bay, Florida, a simple model was developed to predict 61 spatial and temporal distributions of suspended solids in turbidity plumes. No well-defined plumes of dissolved metals were observed at sites, indicating dissolution of metals from suspended solids was limited. Increased concentrations of suspended solids and particle-associated metals in receiving waters was associated with discharge plume. Concentrations of dissolved ammonia and silica increased near discharge; however, no increases in dissolved phosphate were noted, despite high dissolved phosphate concentrations in interstitial water of channel sediment being dredged. Elutriate test results using channel sediment had limited use predicting changes in concentrations of dissolved metals during open-water disposal operations. A simple model was developed to predict concentrations of particle-associated constituents. Although large quantities of reduced sediment with high oxygen demand enter the water column during open-water pipeline disposal operations, little is reactive on a time scale comparable to that associated with majority settling of dredged material slurry. (WES)
W79-07524

AQUATIC DISPOSAL FIELD INVESTIGATIONS ASHTABULA RIVER DISPOSAL SITE, OHIO, APPENDIX C, INVESTIGATION OF WATER-QUALITY AND SEDIMENT PARAMETERS.
State Univ. of New York Coll. at Buffalo. Great Lakes Lab.
For primary bibliographic entry see Field 5C.
W79-07525

HABITAT DEVELOPMENT FIELD INVESTIGATIONS, BUTTERMILK SOUND MARSH DEVELOPMENT SITE, ATLANTIC INTRACOASTAL WATERWAY, GEORGIA; SUMMARY REPORT.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
R. A. Cole.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A057 937. Price codes: A03 in paper copy, A01 in microfiche. Technical Report D-78-26, July 1978. 34 p, 2 tab, 9 ref.

Descriptors: rial, *Was sound(Georg

A summary during the h at Buttermilk la River in 1977. A tion, mic animal respo regarding ha sented in Ap W79-07526

HANDBOOK: HABITAT MATERIAL.
Ocean Data Coastal Zone Available from Service, Spr Price codes: Army Engin Vicksburg, M July 1978. 35 tib.

Descriptors: ata, *Dredged

This study o ment on dre United State published da general list cover value t state; a syno species chose their importa and geograp cludes a desc requirements use and ins range map a appropriate book also oug oping terrestr rial; discuss material area propagation, plantings. (W W79-07527

A FIELD ST MATERIALS DISPERSAL.
Virginia Inst. M. M. Nichol Available from Service, Spr Price codes: Army Engin Vicksburg, M July 1978. 84

Descriptors: *Mobile Bay, *Dredged ma

Open-water o mud with co studied at fie the James Riv and in disper sion of turbid dredged mat Mobile Bay s mud near the was disperseo pended solids to the fluid s pension and deposit sprea dredged area red, forming high having the fluid mud and slopes mud the James River 1 year. More

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Descriptors: *Habitats, *Marshes, *Dredged material, *Waste disposal sites, *Buttermilk sound (Georgia), *Habitat development.

A summary is presented of activities that occurred during the habitat development field investigation at Buttermilk Sound near the mouth of the Altamaha River in Glynn County, Georgia, between 1975 and 1977. A general discussion of salt marsh propagation, microbial development, and associated animal responses is included. Detailed information regarding habitat development at this site is presented in Appendix A to this report. (WES) W79-07526

HANDBOOK FOR TERRESTRIAL WILDLIFE HABITAT DEVELOPMENT OF DREDGED MATERIAL.

Ocean Data Systems, Inc., Wilmington, NC. Coastal Zone Resources Div. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A061 114. Price codes: A17 in paper copy, A01 in microfiche. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Technical Report D-78-37, July 1978. 391 p, 2 tab, 109 fig, 3 append, 177 ref, 166 ref.

Descriptors: *Terrestrial habitats, *Wildlife habitats, *Dredged material, *Habitat development.

This study of terrestrial wildlife habitat development on dredged material within the contiguous United States compiles existing published and unpublished data into a user-oriented handbook. A general list of 250 plant species with food and cover value for wildlife is indexed by life form and state; a synopsis is given for each of 100 plant species chosen from the general list on the basis of their importance to wildlife, ease of establishment, and geographic distribution. Each synopsis includes a description and discussion of habitat, soil requirements, establishment and maintenance, disease and insect problems, and wildlife value. A range map and illustrations are given along with appropriate miscellaneous comments. The handbook also outlines a suggested approach for developing terrestrial wildlife habitat on dredged material; discusses wildlife species inhabiting dredged material areas; and recommends techniques for propagation, establishment, and maintenance of plantings. (WES) W79-07527

A FIELD STUDY OF FLUID MUD DREDGED MATERIAL: ITS PHYSICAL NATURE AND DISPERSAL.

Virginia Inst. of Marine Science, Gloucester Point. M. M. Nichols, G. S. Thompson, and R. W. Faas. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A058 952. Price codes: A05 in paper copy, A01 in microfiche. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Technical Report D-78-40, July 1978. 84 p, 1 append, 5 tab, 28 fig, 21 ref.

Descriptors: *Mud, *Dispersion, Turbidity, *Mobile Bay (Ala), *James River (Va), *Fluid mud, *Dredged material, *Open water disposal.

Open-water disposal of dense suspensions of fluid mud with concentrations of 10 to 480 g/l was studied at field sites in Mobile Bay, Alabama, and the James River, Virginia. The significance of fluid mud in dispersal of dredged material and in generation of turbidity was examined. The bulk of the dredged material, more than 99 percent at the Mobile Bay site, was dispersed in the form of fluid mud near the bottom, whereas less than 1 percent was dispersed through the water column. As suspended solids flocculate and settle, they contribute to the fluid mud. In turn, fluid mud resists resuspension and reduces turbidity. Disposal created a deposit spread over an area 5 to 13 times the dredged area in the channel. Disposal raised the bed, forming dense layers in mounds 0.8 to 2.2 m high having slopes 1:125 to 1:2000. After disposal, the fluid mud consolidated, bulk density increased, and slopes decreased. Height and volume of the James River mound decreased about 50 percent in 1 year. More field investigations of the movement

of fluid mud are needed for a detailed understanding of its dynamics. (WES) W79-07528

HABITAT DEVELOPMENT FIELD INVESTIGATIONS, PORT ST. JOE SEAGRASS DEMONSTRATION SITE, PORT ST. JOE, FLORIDA; SUMMARY REPORT.

Seattle Pacific Univ., WA. R. C. Phillips, M. K. Vincent, and R. T. Huffman. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A058 733. Price codes: A04 in paper copy, A01 in microfiche. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Technical Report D-78-33, July 1978. 52 p, 7 tab, 5 fig, 1 app, 20 ref.

Descriptors: *Habitats, Plant growth, *Dredged material, *Seagrasses, *Habitat development, *Port St. Joe (Fla).

Transplants of shoal grass (*Halodule wrightii*) at Port St. Joe, Florida, indicate that it may be feasible to propagate seagrass on dredged material. Using the plug technique, two sizes of plugs were removed from a natural meadow and planted on coarse-grained dredged material at three different spacing intervals. Many of the transplants demonstrated a significant amount of growth before the project failed nearly 13 months after planting. Best growth was obtained with 375-cm² plugs planted on 0.9-m centers. The reason for the project failure is not known, but it is hypothesized that the factors involved included stresses from an unusually cold winter, exposure, erosion, sedimentation, variation in water quality, and heavy surf. While the study indicates that seagrass propagation on dredged material has promise, further field study is needed. (WES) W79-07531

MICROBIOLOGICAL STUDIES ON THE NITROGEN CYCLE IN AQUATIC ENVIRONMENTS - V NITROGEN METABOLISM IN THE GOLDFISH CULTURING POND.

Kyoto Univ., (Japan). Research Inst. for Food Science. For primary bibliographic entry see Field 5B. W79-07592

NITROGEN AND PHOSPHORUS REMOVAL FROM SEWAGE EFFLUENT WITH HIGH SALINITY BY CHORELLA SALINA.

Chinese Univ. of Hong Kong. Dept. of Biology. For primary bibliographic entry see Field 5D. W79-07643

DEMONSTRATION OF A LEACHATE TREATMENT PLANT.

Applied Technology Associates, Philadelphia, PA. For primary bibliographic entry see Field 5D. W79-07775

COST OF LANDSPREADING AND HAULING SLUDGE FROM MUNICIPAL WASTEWATER TREATMENT PLANTS. CASE STUDIES.

Environmental Protection Agency, Washington, DC. Office of Solid Waste. R. K. Anderson, B. R. Weddle, and T. Hillmer. Available from the National Technical Information Service, Springfield, VA 22161 as PB-274 875. Price codes: A08 in paper copy, A01 in microfiche. Report EPA/530/SW-619, 1977. 149 p, 13 fig, 6 tab, 1 append.

Descriptors: *Ultimate disposal, *Municipal wastes, *Sludge disposal, *Costs, *Dewatering, Filtration, Waste water treatment, Personnel, Agricultural, Land use, Application methods.

The cost of disposing of municipal wastewater treatment sludge on land by existing operations was investigated by an on-site survey of 24 communities. The municipal plants surveyed were small to medium in size with throughputs of less than 100 mgd. A cost analysis indicated that landspreading liquid sludge was far less expensive than landspreading sludge dewatered by vacuum filtra-

tion. Communities that disposed of liquid sludge had an average cost of \$32.00 per dry ton, while those that dewatered their sludge averaged \$87.00 per dry ton. Personnel costs represented the largest single cost item for both liquid and dewatered sludge landspreading. Liquid sludge was more acceptable to farmers than dewatered sludge because the municipality spread the liquid sludge. Dewatered sludge was more difficult to spread. (Small-FRC) W79-07777

TREATMENT AND STABILIZATION OF POLYCHLORINATED BIPHENYLS (PCBS) CONTAMINATED WATER AND WASTE OIL-A CASE STUDY. WHITEHOUSE, FLORIDA.

Environmental Protection Agency, Atlanta, GA. Region IV. For primary bibliographic entry see Field 5D. W79-07778

LINER MATERIALS EXPOSED TO HAZARDOUS AND TOXIC SLUDGES.

Matrecon, Inc., Oakland, CA. For primary bibliographic entry see Field 8G. W79-07779

ON-LAND DISPOSAL OF MUNICIPAL SEWAGE SLUDGE: A GUIDE TO PROJECT DEVELOPMENT (INTERIM REPORT).

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering. M. H. Lutkin, J. L. Smith, and D. B. McWhorter. Available from the National Technical Information Service, Springfield, VA 22161 as PB-271 144. Price codes: A07 in paper copy, A01 in microfiche. Report NSF/RA-770165, 1977. 151 p, 12 fig, 14 tab, 93 ref, 2 append.

Descriptors: *Sewage sludge, *Sludge disposal, *Land management, *Application methods, *Treatment facilities, Design criteria, Design data, Project planning, Municipal wastes.

A technique for planning a land application facility for municipal sewage sludge disposal was developed. A literature review of pertinent background material included an overview of permits and approval processes; pathogenic microorganisms; inorganic and organic contaminants; potential surface conditions at a field location; a discussion of potential subsurface conditions, including groundwater and soil water movement, soil properties, and procedures for obtaining data; and the impact of climate and sludge application on operation. Important factors in project development were identified and practical data from existing operations were utilized to provide guidelines for site selection, overall design, and monitoring techniques. The application of the data by a designer or administrator for developing a land application facility was demonstrated with a hypothetical project. (Lisk-FRC) W79-07780

ASSESSMENT IN INDUSTRIAL HAZARDOUS WASTE MANAGEMENT PETROLEUM RE-FINING INDUSTRY.

J. W. Swain. Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 267. Price codes: A08 in paper copy, A01 in microfiche. Report, 1977. 160 p, 3 fig, 44 tab, 30 ref, 6 append.

Descriptors: *Oil industry, *Landfills, *Leachate, *Neutralization, *Cooling water, Sludge, Lead, Zinc, Phenols, Waste disposal, Waste water treatment, Industrial wastes.

Waste management practices in 27 petroleum refining plants which generate lubricants and fuels from waste oils are reviewed. The refining process utilizes pretreatment with heat and chemicals, distillation with bleaching clay, and post treatment with filtration and acid neutralization. Wastes generated by these processes include acid or caustic sludges and spent clay wastes. Sources of waste water include water in raw waste which settles during storage, groundwater runoff containing oil

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5E—Ultimate Disposal Of Wastes

from spills and leakage, process cooling water, and steam stripping water. The latter waste water is considered the most hazardous, containing lead, zinc, phenols, and hexane solubles. Treatment and disposal techniques practiced by the industry include the use of on-site or off-site landfills without treatment of wastes, landfilling with prior acid neutralization or fixative material treatment, or the use of chemically secure landfills with or without waste treatment. Projections for production of re-refined oil and production of wastes were made for 1977 and 1983. (Lisk-FRC)
W79-07781

FINAL REPORT ON FATE OF METALS APPLIED IN SEWAGE AT LAND WASTEWATER DISPOSAL SITES,
Texas A and M Research Foundation, College Station.
For primary bibliographic entry see Field 5B.
W79-07789

UTILIZATION OF SOIL INVERTEBRATES IN STABILIZATION, DECONTAMINATION, AND DETOXIFICATION OF RESIDUAL SLUDGES FROM TREATMENT OF WASTEWATER (INTERIM REPORT),
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Biology, Chemistry and Ecology.
R. Hartenstein, and M. J. Mitchell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-271 141, Price codes: A07 in paper copy, A01 in microfiche. Report NSF/RA-770138, 1977. 133 p, 5 fig, 15 tab, 45 ref, 11 append.

Descriptors: *Sludge treatment, *Biological treatment, *Organic matter, *Worms, *Degradation, Odor, Toxicity, Salmonella, Nematodes, Stabilization.

The problem of reducing organic matter content in sludge without destroying the biological value of sludge to the soil ecosystem was reviewed. Earthworms may be used to convert a relatively infertile sludge into a fertile, organic topsoil. In combination with nematodes, bacteria, and other microorganisms, earthworms can deodorize soil, destroy salmonella, and reduce the unstable organic content of sludges. Research projects are reviewed on the following topics: sludge toxicity to earthworms, degradation and stabilization of sludge, modification of certain chemical properties of sludge, effect of soil macroinvertebrates on bacterial and nematode populations, and effect of earthworms on salmonella typhimurium. Reports of various studies constitute the bulk of this document. (Small-FRC)
W79-07802

SLUDGE INCINERATION SYSTEMS FOR PURIFICATION AND RESOURCE RECOVERY,
Envirotech Corp., Menlo Park, CA.
F. P. Sebastian.
In: Handling, Treatment and Disposal of Wastewater Sludge, p 8-26, 1975. 10 fig, 8 ref.

Descriptors: *Sewage sludge, *Incineration, *Recalcination, *Polychlorinated biphenyls, *Drying, Oxidation, Heat treatment, Sludge disposal, Ultimate disposal, Waste water treatment, Sewage treatment, Sludge treatment, Municipal wastes.

The use of multiple hearth furnaces for the incineration or drying of various municipal sludges is discussed. Multiple hearth furnaces may also be used for burning or drying raw sludge, digested sludge, and sewage greases; recalcining lime sludge and waste pond sludge; reclaiming various industrial wastes; regenerating spent activated carbon and diatomaceous earth. The multiple hearth furnace is a refractory containing a series of hearths; in the upper hearths, the feed is dried to about 48% moisture, in the incineration/deodorization zone, the temperature is maintained at 760-982°C, and in the cooling zone, hot ash contributes its heat to incoming combustion air. Tests for polychlorinated biphenyl (PCB) destruction in incinerated sludge indicated that at 371°C, 95% PCB destruction was

achieved at 0.1 sec exhaust gas detention time and at 593°C, 99.9% destruction was achieved at the same detention time. The importance of PCB destruction is reviewed and the impacts of incineration on air quality are discussed. The incineration of certain sludges also permits the reclamation of lime and/or energy and the recovery of ash as a fertilizer. Costs associated with thermal oxidation of sludges are discussed. (See also W79-07825) (Lisk-FRC)
W79-07827

MANAGEMENT OF OIL SLUDGE FROM A REFINERY WASTE WATER TREATMENT PLANT,
Bashkirian Scientific Research Inst. of Petroleum Refining (USSR).
E. G. Ioakimis, and A. D. Davletov.
In: Handling, Treatment and Disposal of Wastewater Sludge, p 27-35, 1975. 6 fig.

Descriptors: *Incineration, *Oil wastes, *Sludge treatment, *Oil industry, *Sludge disposal, Pilot plants, Industrial wastes.

Systems currently employed in the USSR for the incineration of oil sludge from refineries are described. Pilot plant studies of rotary drum kiln incinerators indicated that combustion is incomplete with about 28% of the non-combusted materials exhausted with the off-gases. Furnaces with bubble burners are considered simple and operate by separating water from the sludge prior to incineration in the kiln. These furnaces are capable of incinerating aged emulsions and oil sludges containing up to 5% solids and 35-40% petroleum products but lack ash-catching facilities. In fluid-bed incinerators, the sludge is pretreated and incinerated in a sand fluid bed of a vertical kiln where mechanic burners atomize fuel, oil sludge and cooling water. However, air temperatures of 600°C for fluidization are required to provide normal operation of the incinerator with oil sludges and problems have been encountered attempting to improve the efficiency of the system. In an incinerator which was modified from a fluid bed to torch burning under the use of a rotary burner, the sludge intake and pretreatment, the sludge feed to the incinerator, and its atomizing, cooling off-gases were modernized. The modifications to the system permitted an average capacity of 2.7 tons/hr with a maximum capacity of 4 tons/hr when incinerating sludge containing 25-27% petroleum products and 5-10% solids. The flow diagram for the system is illustrated. (See also W79-07825) (Lisk-FRC)
W79-07828

MODERN STATE AND PRINCIPAL TRENDS IN TECHNOLOGY DEVELOPMENT FOR WASTEWATER SLUDGE TREATMENT,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidroteologii, Gosstro (USSR).
G. S. Altovsky.
In: Handling, Treatment and Disposal of Wastewater Sludge, p 36-38, 1975.

Descriptors: *Sewage sludge, *Sludge treatment, *Dewatering, *Separation techniques, *Incineration, Anaerobic digestion, Sludge digestion, Flocculation, Heat treatment, Sludge disposal, Municipal wastes.

Municipal sludge treatment and disposal methodology is discussed and areas for improvement and research are identified. Common sludge treatment practices include gravity thickening, flotation, centrifugal separation, vibrothickening, stabilization by anaerobic or aerobic digestion, addition of reagents such as ferric chloride and lime, heat treatment, flocculation with high molecular polyelectrolytes, vacuum filtration, pressure filtration, centrifugal dewatering, vibrofiltration, and incineration. Improvements in sludge heat treatment systems required include: heat treatment for sludge conditioning prior to dewatering, heat drying of dewatered sludges for utilization in agriculture, and incineration of unutilized sludge to reduce the mass. Developments and improvements are also required for vibrothickening and dewatering

equipment and plants, flocculation agents, and centrifugal separators. Agricultural and sanitary-hygienic evaluations of waste water sludges are also necessary. (See also W79-07825) (Lisk-FRC)
W79-07829

MANAGEMENT AND DISPOSAL OF RESIDUALS FROM TREATMENT OF INDUSTRIAL WASTEWATERS,
Environmental Protection Agency, Washington, DC. Industrial Pollution Control Div.
W. J. Lacy, and A. Cywin.
In: Handling, Treatment and Disposal of Wastewater Sludge, p 39-52, 1975.

Descriptors: *Industrial wastes, *Waste treatment, *Waste disposal, *Waste water treatment, *Waste water disposal, Sludge treatment, Sludge disposal, Hazards.

A summation of eleven reports presented at the National Conference on Management and Disposal of Residues from the Treatment of Industrial Wastewaters is presented. The topics discussed by each speaker at the conference are summarized and the cover pages of the reports are reproduced. The speakers were affiliated with the U.S. Environmental Protection Agency and various industries and utilities. The various problems with and methods of treating and disposing of these wastes as discussed by the participants are summarized. (See also W79-07825) (Lisk-FRC)
W79-07830

INDUSTRIAL SLUDGE DISPOSAL PRACTICES,
Environmental Protection Agency, Washington, DC. Industrial Pollution Control Div.
W. J. Lacy, and A. Cywin.
In: Handling, Treatment and Disposal of Wastewater Sludge, p 53-62, 1975.

Descriptors: *Industrial wastes, *Chemical wastes, *Chemical industry, *Oil industry, *Food industry, Textiles, Dairy industry, Pulp and paper industry, Sludge treatment, Water reuse, Recycling, Tannery wastes, Waste water treatment, Waste water disposal.

The characteristics of various industrial wastes and costs and methods of treating and disposing of industrial sludges are summarized. The industrial sludges discussed are generated from the apple, citrus, and potato processing industries; building, construction, and paper industries; sugar beet processing; dairy product processing; flat glass production; grain processing; unbleached kraft and semi-chemical pulp industries; leather tanning and finishing processes; inorganic products industry; red meat processing; smelting and slag processing; steel production; synthetic resins industry; petroleum refining; phosphorus derived chemicals production; textile mills; tire and synthetics industry; and synthetic resins industries. Many of the treatment processes recover residual and reusable materials such as product fines, usable water, and thermal energy. (See also W79-07825) (Lisk-FRC)
W79-07831

THICKENING AND DEWATERING OF WASTE WATER SLUDGES BY VIBRO FILTRATION METHOD,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidroteologii, Gosstro (USSR).
E. V. Dvinskii.

In: Handling, Treatment and Disposal of Wastewater Sludge, p 63-67, 1975. 4 fig, 1 tab.

Descriptors: *Filtration, *Sludge treatment, *Separation techniques, *Mathematical models, *Screens, Vibrations, Dewatering, Filters, Activated sludge, Industrial wastes, Municipal wastes.

Mathematical models for the vibrofiltration of municipal and industrial sludges were developed to describe the thickening and dewatering processes. The study utilized a model of a continuous gravity vibrofilter with directed vibrations of the filtering media in the frequency range of 20-100 Hz and

Ultimate Disposal Of Wastes—Group 5E

acceleration of 10g. Metal screens as the filter media were found to be better than synthetic cloth because the cloth dissipated the vibrations. The process of sludge dewatering by vibrofiltration was found to occur in two stages. In the first stage, a layer of sludge with a higher solids content than incoming sludge formed on the filtering screen and was covered by a layer of sludge suspension containing a solids content similar to that of the initial suspension. When this layer decreases to zero, the second stage begins in initial suspension. When this layer decreases to zero, the second stage begins in which the sludge layer decreases due to the separation of filtrate. The solids concentration of the sludge layer constantly increases but the solids concentration gradient on the layer depth is maintained at zero during the second stage of the filtration process. Mathematical models of both process stages were developed. The vibrofiltration process was tested for thickened activated sludge, primary sludge, digested coagulated sludge, a mixture of primary and thickened activated sludge, sludge from wood-fibered slab plants, and sludge from blast furnace gas-cleaning process. (See also W79-07825) (Lisk-FRC) W79-07832

MUNICIPAL SLUDGE MANAGEMENT RESEARCH PROGRAM IN THE U.S.A.,

National Environmental Research Center, Cincinnati, OH. Advanced Waste Treatment Research Lab.

J. E. Smith, and W. A. Rosenkranz.

In: Handling, Treatment and Disposal of Wastewater Sludge, p 68-77, 1975. 17 ref.

Descriptors: *Sludge treatment, *Sludge disposal, *Heat treatment, *Sludge digestion, *Chemical degradation, Landfills, Application methods, Filtration, Dewatering, Incineration, Chemical wastes, Activated sludge, Waste water treatment, Municipal wastes.

Current and developing methods for the treatment and disposal of municipal sludges are reviewed. Methods of treating and disposing of sludges in current practice include ocean dumping, pasteurization, sterilization, heat treatment, wet oxidation, composting and heat drying, pyrolysis, and co-incineration with solid wastes; some of these processes produce usable by-products. Land application techniques include liquid spreading, landfilling, and trenching. The addition of alum, lime, ferric chloride, or polyelectrolytes during waste water treatment can upgrade treatment efficiencies. Waste chemical sludge and waste activated sludge may be treated with lime stabilization, autothermal thermophilic aerobic digestion, ash conditioning, thermal conditioning, top-feed rotary vacuum filtration, moving belt filter presses, pressure filtration, pyrolysis, and wet oxidation. (See also W79-07825) (Lisk-FRC) W79-07833

INORGANIC SUSPENDED SLUDGE DEWATERING,

Leningrad Civil Engineering Inst. (USSR). I. S. Lavrov, N. F. Feodorov, and V. N. Ponomareva.

In: Handling, Treatment and Disposal of Wastewater Sludge, p 78-80, 1975. 4 fig. 1 tab.

Descriptors: *Dewatering, *Sludge, *Flocculation, *Coagulation, *Electric currents, Vacuum drying, Electrodes, Separation techniques, Suspension, Industrial wastes, Sludge treatment.

Parameters investigated during dewatering experiments with a flocculant sludge of metal hydroxides from galvanic work and a concentrated silicate-sulfate sludge from refractory, ceramic, and abrasive industries included: chemical composition of the solids and liquid phases, electrical conductivity, acidity, dispersion degree, stability, zeta-potential, and the effects of the coagulants and flocculants. The refractory suspension was dosed with 40 and 75 mg/liter aluminum sulfate or with 0.1-25 mg/liter polyacrylamide. Flocculants were found to be a suitable separation technique followed by compression in the hydroxide systems; a combination of coagulants and flocculants were considered

more suitable for refractory suspensions. Electric field treatment with voltages in the range of 5-150 v/cm indicated that sludge compression was complete within 5 min of electrical treatment. Electric treatment of refractory sludges when 40-75 mg/liter of aluminum sulfate was injected permitted a reduction in voltage from 125 to 50 v/cm. The effect of electric treatment of sludges on the hydrodynamic specific resistance and efficiency of vacuum filtration of the sludges was also evaluated. (See also W79-07825) (Lisk-FRC) W79-07834

DEWATERING OF SEWAGE SLUDGE BY MEANS OF CENTRIFUGES,

R. Ya. Agranonick.

In: Handling, Treatment and Disposal of Wastewater Sludge, p 81-84, 1975. 2 tab, 3 ref.

Descriptors: *Centrifugation, *Sewage sludge, *Activated sludge, *Separation techniques, *Dewatering, Chemical degradation, Heat treatment, Sludge digestion, Waste water treatment, Sludge treatment, Municipal wastes.

Centrifuge dewatering was studied with raw or digested primary sludge, a mixture of digested primary and activated sludge, and raw activated sludge containing 28-35% or 38-42% ash. The solid-bowl scroll centrifuge had the advantages of compactness, elimination of the need for chemical additions, and production of transportable sludge with low moisture content. The dewatered sludge cakes had final moisture contents ranging from 65-80%. The centrifuge was also considered useful in low capacity plants with flows to 5,000 cu m. The large quantities of centrate produced by the centrifuge system may be utilized as return sludge, discharged to preliminary settling tanks, treated with combined aerobic and anaerobic digestion when originating from activated sludge mixture centrifugation, or dried in beds when originating from digested sludge. Chemical pretreatment and heat conditioning did improve the efficiency of the centrifuge but were not necessary. (See also W79-07825) (Lisk-FRC) W79-07835

THERMAL DRYING OF DEWATERED SEWAGE SLUDGE,

L. L. Goldfarb.

In: Handling, Treatment and Disposal of Wastewater Sludge, p 85-87, 1975.

Descriptors: *Sludge treatment, *Dewatering, *Drying, *Heat treatment, *Jets, Nozzles, Moisture content, Gases, Waste water treatment, Sludge disposal, Municipal wastes.

Methods of thermally drying mechanically dewatered sewage sludge were evaluated. Thermal drying of sludges reduces the volume and produces a disinfected, dry, loose, granulated or powdery material suitable as a fertilizer or fuel. Continuous convective dryers utilized in thermal drying of dewatered sludge include rotating, belt, loop, and pipedryers. However, these systems have high fuel consumption and certain operating or efficiency problems. A system of counterjet drying of mechanically dewatered sludge was found to be efficient and economical. In this system, sludge is fed into the dryer and 600-800°C fuel gas is injected at 100-400 m/sec from a combustor through nozzles. The sludge is fed to the nozzle shears, comminuted with the hot gas, and passed to two oncoming jets where the streams collide, supplementary sludge disperses, and intensive drying occurs. Insufficiently dried sludge is returned to the dryer and gases are purified prior to discharge. The dried sludge has a moisture content of 30-45%. The dryers are compact, fully automated, simple to operate, and have significantly reduced capital and operating costs. (See also W79-07825) (Lisk-FRC) W79-07836

AEROBIC STABILIZATION OF ACTIVATED SLUDGE,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodostokhneniya, Kanalizatsii i Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Hidro-Geologii, Gos-

stroj (USSR).

A. V. Abramov.

In: Handling, Treatment and Disposal of Wastewater Sludge, p 88-92, 1975. 4 fig.

Descriptors: *Mathematical models, *Stabilization, *Sludge treatment, *Aerobic treatment, *Equations, Analytical techniques, Activated sludge, Mathematical studies, Waste water treatment, Municipal wastes.

Mathematical models were developed to describe primary regularities of excess activated sludge aerobic stabilization. Equations are provided for calculating the degradation limit; the degradation value; the degradation rate; the oxygen uptake rate; the specific oxygen uptake; the required detention time for complete-mixing reactors, for plug-flow reactors, and for multi-cell reactors; gas release values for stabilized and inflowing sludges, and sludge age. Guidelines and recommendations for utilizing the equations are provided and the aerobic stabilization process and the interrelationships of certain factors in the equations are illustrated. (See also W79-07825) (Lisk-FRC) W79-07837

UTILIZATION OF MUNICIPAL SLUDGE IN AGRICULTURE,

B. T. Lynam, C. Lue-Hing, R. R. Rimkus, and F. C. Neil.

In: Handling, Treatment and Disposal of Wastewater Sludge, p 110-143, 1975. 10 fig. 17 tab, 37 ref.

Descriptors: *Ultimate disposal, *Agriculture, *Sewage sludge, *Application methods, *Land use, Irrigation systems, Costs, Public health, Monitoring, Crop response.

The utilization of municipal sludge in agriculture is reviewed as a means for the disposal of waste water solids in a technically feasible and socially acceptable manner. The properties of sewage sludge are discussed including plant nutrient levels. Sludge land application rates and their relationship to crop production and reclamation of spoils are discussed. Site selection, design, and management are considered with discussion of topography and soil factors, site preparation, site management, and public relations. Irrigation systems are discussed including soil incorporation and injection systems and Slurry, cake, and solids handling systems. Soil and crop responses to sludge application are explored, and environmental monitoring of the sludge application process is described including public health aspects. Costs of sludge application are presented for Fulton County, Illinois. (See also W79-07825) (Small-FRC) W79-07840

PROCEEDINGS OF THE SEMINAR ON CURRENT APPROACHES IN WASTEWATER TREATMENT,

For primary bibliographic entry see Field 5D. W79-07842

OPERATIONAL EXPERIENCE WITH THE ZIMPRO LOW-PRESSURE WET AIR OXIDATION PROCESS,

Gore and Storrie Ltd., Toronto (Ontario). P. F. da Silva.

In: Proceedings of the Seminar on Current Approaches in Wastewater Treatment, April 5, 1978, Ontario Ministry of Health Laboratories, Toronto, Canada, p 37-45, 1978. 1 fig. 2 tab.

Descriptors: *Sewage sludge, *Dewatering, *Heat treatment, *Vacuum drying, *Oxidation, Filtration, Odor, Incineration, Steam, Sludge treatment, Sludge disposal, Municipal wastes.

Two 200 imperial gpm streams will be added to the Zimpro wet air oxidation units at the Lakeview Water Pollution Control Plant in Canada. The existing units have been operating for three years. Digested, gravity thickened waste activated and raw sludges are blended with propeller-type mixers in the blending tanks, macerated, and pressurized under aeration. The sludge mixture is then preheat-

Group 5E—Ultimate Disposal Of Wastes

STRENGTH PROPERTIES OF LIQUID-BORNE FLOCCULATED MATTER,
Delaware Univ., Newark. Dept. of Civil Engineering.
J. E. Quigley.
Available from the National Technical Information

The results of the Environmental Protection Agency's investigation of methods of reducing waste

WATER QUALITY CONTROL AND BLOOMINGTON LAKE,
Corps of Engineers, Baltimore, MD. Baltimore District.

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Techniques Of Planning—Group 6A

For primary bibliographic entry see Field 8A.
W79-07979

5G. Water Quality Control

RESERVOIRS AND WATERWAYS; IDENTIFICATION AND ASSESSMENT OF ENVIRONMENTAL QUALITY PROBLEMS AND RESEARCH PROGRAM DEVELOPMENT, Army Engineer Waterways Experiment Station, Vicksburg, MS.

J. W. Keeley, J. L. Mahloch, J. W. Barko, D. Gunnison, and J. D. Westhoff.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A060 729, Price codes: A08 in paper copy, A01 in microfiche. Technical Report E-78-1, July 1978. 152 p, 25 fig, 15 tab, 94 ref.

Descriptors: *Environmental effects, *Reservoirs, *Channels, *Water quality, *Research.

Presents results of an effort to identify and assess environmental quality problems associated with Civil Works activities of the Corps of Engineers (CE) and a recommended research program to address these problems. Visits to all CE Division offices and subsequent submission of written information from field offices revealed six key problem areas related to current practices and identified priority research needs. The ability to predict the environmental impact of operational alternatives or proposed projects is needed including hydrodynamic, chemical, and biological aspects. Operational problems relative to fluctuating water levels, minimum releases, and filling alternatives for reservoirs have been documented, and research on this is required. Flood control and navigation projects within waterways have environmental impacts that, for the most part, have not been documented or specifically related to CE activities in waterways. Research is required to document those impacts and provide technology for alleviating adverse impacts. Comprehensive techniques for water resources management harmonious with environmental quality objectives on a regional basis are inadequate or require verification. A research program to address the stated problems should involve applied research with extensive field studies to verify program results. A \$30 million, six-year research program has been proposed to address these problems. (WES)
W79-07522

ASPECTS OF STATE-WIDE EMERGENCY RESPONSE PROGRAMS FOR MUNICIPAL WASTEWATER TREATMENT FACILITIES PROGRAM,

Wiley and Wilson, Inc., Lynchburg, VA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-279 551, Price codes: A04 in paper copy, A01 in microfiche. Report, 1974. 77 p, 5 fig, 131 ref, 3 append.

Descriptors: *Municipal wastes, *Water pollution sources, *Regulation, *Overflow, *Discharge(Water), Flow, Streams, State governments, Federal government.

Information is provided to assist in the development of state emergency programs for spills of raw or inadequately treated municipal wastewater. Existing and proposed Federal statutes and current state water pollution laws are reviewed. Over 55 state and interstate agencies were asked to provide information on existing or future water pollution contingency plans, and over 200 wastewater treatment facilities were asked to provide information on emergency plans. Few states were found to require reporting of spills or had contingency plans specific for municipal wastewater spills. Very few municipal treatment systems had formal emergency response plans. It is recommended that states develop regulations and emergency response plans to deal with possible spills. Flow models of critical streams should also be developed. Further, emergency equipment and personnel inventories are recommended. (Small-FRC)
W79-07797

HIGHLIGHTS OF THE CLEAN WATER ACT OF 1977,

For primary bibliographic entry see Field 5D.
W79-07874

LAND APPLICATION OF WASTEWATER AND STATE WATER LAW: STATE ANALYSES VOLUME II,

Wisconsin Univ.-Madison. School of Law.
For primary bibliographic entry see Field 6E.
W79-07876

A REVISION OF EXISTING REGULATIONS OF THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM,

Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 6E.
W79-07883

CONSERVATION DISTRICTS AND 208 WATER QUALITY MANAGEMENT-NON-POINT SOURCE IDENTIFICATION AND ASSESSMENT, SELECTION OF BEST MANAGEMENT PRACTICES, MANAGEMENT AGENCIES, REGULATORY PROGRAMS,

National Association of Conservation Districts, Washington, DC.
For primary bibliographic entry see Field 4A.
W79-07886

NATIONAL WATER QUALITY GOALS CANNOT BE ATTAINED WITHOUT MORE ATTENTION TO POLLUTION FROM DIFFUSED OR 'NONPOINT' SOURCES,

General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 2E.
W79-07889

GROUND AND SURFACE WATER IN NEW MEXICO: ARE THEY PROTECTED AGAINST URANIUM MINING AND MILLING,

For primary bibliographic entry see Field 6E.
W79-07896

HARBOR LINES AND THE PUBLIC TRUST DOCTRINE IN WASHINGTON NAVIGABLE WATERS,

Washington Univ., Seattle. School of Law.
For primary bibliographic entry see Field 4C.
W79-07897

ANALYSES OF 1975-76 MICROZOOPLANKTON SAMPLES FROM TRANSECT II,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
P. L. Johansen.

In: 'Environmental Studies, South Texas Outer Continental Shelf, Biology and Chemistry,' Texas University Marine Science Institute, Supplemental Reports to Contract AA550-CT6-17, to the Bureau of Land Management, p 2-1 - 2-44, 1979. 1 fig, 4 tab, 9 ref, 2 append. AA550-CT6-17.

Descriptors: *Texas, *Zooplankton, *Biomass, *Water quality, Monitoring, Protozoa, Temporal distribution, Spatial distribution, Water pollution effects, Baseline studies, Resources development, Environmental effects, *Outer Continental Shelf, Petroleum development, Diversity index, Ciliated protozoa, Oligotrichs, Tintinnids, Foraminifera, Radiolaria, Acantharia, South Texas Outer Continental Shelf(STOCS).

Seventy-two (72) one liter samples were collected from the BLM-STOCS Transect II during 1975 and 1976. During November and December 1976, the protozoan biomass ranged from three to seventeen percent of the macrozooplankton biomass. Some qualitative information was obtained from the remaining data. Oligotrichs as a group were widespread in both time and space, while tintinnids, foraminifera, radiolaria/acantharia and other protozoa tended to be more restricted in both temporal and spatial distribution. It is possible that marine protozoa may serve as both short and long

term indicators of water quality and should therefore be monitored at regular intervals. (Sinha-OEIS)
W79-07916

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

FUTURE RESEARCH NEEDS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. Cairns, Jr.

In: The Freshwater Potomac: Aquatic Communities and Environmental Stresses, p 102-105, 1978. 14 ref. Flynn, K. C., and Mason, W. T., Eds., Interstate Commission on the Potomac River Basin.

Descriptors: *Research and development, *River basin development, *Environmental effects, Modeling, Forecasting, Technology, Methodology, Decision making, Legislation, Manpower, Scientific personnel, Professional personnel, Ecosystems, Protection.

Areas in which research would benefit future studies of the Potomac and other basins are discussed. More programs for professional certification need to be developed to assure professional competency of those engaged in solving environmental problems. The present state-of-the-art for environmental impact statements and other documents reportedly describing the effects of a proposed course of action requires improved methodology in the form of predictive modeling. Existing technology developed for biological monitoring of an ecosystem should be transferred to the industrial and other user groups. Standardizing the methods for the biological assessment of pollution is important, so that the most reliable methods will be used by regulatory agencies and as evidence for major environmental decisions. When environmental legislation was drafted the number of trained personnel and the specialized types of training required were not given the consideration necessary for the successful implementation of these programs. The provision of better man-power estimates with each new piece of legislation is suggested. A willingness to recognize collective effort in research would make more data available to users. (Davison-IPA)
W79-07517

A WATER RESOURCE PLANNING PROCEDURE FOR RURAL TOWNS,

Vermont Univ. Burlington, Research Economics.
F. O. Sargent, P. R. Berke, and E. B. Henson.
Water Resources Bulletin, Vol. 15, No. 2, p 496-505, April 1979. 5 tab, 5 ref. OWRT A-019-VT (3).

Descriptors: *Water resources, *Planning, *Lakes, *Watersheds(Basins), *Rural towns, Management, Land use, Water quality, Lake shores, Development potential, Economic value, Carrying capacity, Vulnerability, Intensity index.

Six new techniques have been developed for lake watershed analysis and water resource management. The techniques are for determining: (1) watershed land use intensity with reference to water quality; (2) lake vulnerability; (3) water quality; (4) watershed carrying capacity; (5) the economic value of the lake; and (6) the potential of undeveloped lakeshore. These analyses are designed for use by rural planning commissions with guidance and assistance from state agencies and the state university. The comprehensive rural watershed land and water use plan developed by this procedure is inexpensive in time and money, understandable by the layman, and scientifically sound. It is based on presently available information. This water resource planning procedure has been demonstrated in several town planning projects. It is suggested that this method, or modification of it, could be adopted in all rural states by a few administrators and without any new enabling or appropriations legislation. (Bell Graf-Cornell)
W79-07561

Field 6—WATER RESOURCES PLANNING

Group 6A—Techniques Of Planning

A RESERVOIR OPERATING MODEL WITH INORGANIC QUALITY CONSTRAINTS FOR THE TRUCKEE RIVER,
Boyle Engineering Corp., Las Vegas, NV.; and Nevada Univ. System, Las Vegas Desert Research Inst.
For primary bibliographic entry see Field 4A.
W79-07562

ON-LAND DISPOSAL OF MUNICIPAL SEWAGE SLUDGE: A GUIDE TO PROJECT DEVELOPMENT (INTERIM REPORT),
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5E.
W79-07780

PROMISING STRATEGIES FOR RESERVING INSTREAM FLOWS,
Dewsnup (Richard L.)/Dallin W. Jensen, Salt Lake City, UT.
D. W. Jensen, E. Hoban, G. Horak, M. Lewis, and R. L. Dewsnup.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-276 046. Price codes: A05 in paper copy, A01 in microfiche. Report FWS/OBS-77/29, Oct 1977, 63 p.

Descriptors: *Stream flow, *Stream improvement, *Water rights, *Water policy, Flow, Flow system, Stream flow forecasting, Fish conservation, Wildlife, Wildlife conservation, Water supply, Appropriation.

The appropriation doctrine is the principal system by which western states allocate the water use. The most promising strategies (methods) for reserving instream flows for fish and wildlife under existing laws are identified, described and evaluated. Twenty-six strategies are discussed including: (1) obtaining an appropriation from state water rights agency; (2) condemning and reallocating existing rights; (3) encouraging the state water permit authority to take advantage of discretionary opportunities; (4) obtaining a moratorium on new appropriations and further stream depletions; (5) enhancing stream flows through contractual arrangements; (6) adopting interagency agreements, regulations, and formal procedures; (7) identifying instream flow requirements of endangered species; (8) including streams within a Wild and Scenic Rivers system; (9) legislatively designating important fishery streams; (10) utilizing water-quality laws; (11) obtaining reservoir space, (12) including stipulations in new and renewed licenses and permits; (13) reauthorizing existing projects; (14) utilizing public trust doctrine; (15) participating in statewide water planning; (16) utilizing federal funding programs; (17) conveying stored water to downstream/users; (18) constructing larger new reservoirs; (19) coordinating operation of multi-reservoir systems and (20) releasing from reservoir sediment storage reserves. (Fortin-Florida)
W79-07878

CONSERVATION DISTRICTS AND 200 WATER QUALITY MANAGEMENT-NON-POINT SOURCE IDENTIFICATION AND ASSESSMENT, SELECTION OF BEST MANAGEMENT PRACTICES, MANAGEMENT AGENCIES, REGULATORY PROGRAMS,
National Association of Conservation Districts, Washington, DC.
For primary bibliographic entry see Field 4A.
W79-07886

WATER RIGHT LAWS AS THEY AFFECT LAND ACQUISITION AND CONSTRUCTION,
Montana State Univ., Bozeman. Center for Interdisciplinary Studies.
For primary bibliographic entry see Field 4A.
W79-07891

PROBLEMS AFFECTING USEFULNESS OF THE NATIONAL WATER ASSESSMENT WATER RESOURCES COUNCIL,
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 4A.

W79-07893

PROTECTING MASSACHUSETTS WETLANDS,
Suffolk Univ., Boston, MA.
For primary bibliographic entry see Field 6E.
W79-07908

CHATTAHOOCHEE RIVER THERMAL ALTERATIONS,
Geological Survey, NSTL Station, MS. Water Resources Div. and Geological Survey, Doraville, GA. Water Resources Div.
H. E. Jobson, L. F. Land, and R. E. Faye.
ASCE Proceedings, Journal of the Hydraulics Division, Vol. 105, No. HY4, Paper 14499, p 295-311, April 1979. 10 fig, 8 ref.

Descriptors: *Thermal pollution, *Streamflow, *Model studies, *Forecasting, *Water temperature, Powerplants, Cooling water, Mathematical models, Computer models, Heat transfer, Heat balance, Analytical techniques, Georgia, *Chattahoochee River(Ga).

A coupled flow-temperature model, developed previously for use with highly unsteady flow, was applied to a 43.12-mile reach of the Chattahoochee River starting in the urbanized section of Atlanta, Ga. The thermal regime of the modeled reach is modified by upstream reservoirs and includes the cooling-water discharge from the Atkinson and McDonough Power Plants which increases the river temperature by as much as 8.4 C. A linear, implicit finite-difference flow model was calibrated by use of a depth profile obtained at steady low flow as well as unsteady flow data obtained in July 1976. The flow model was verified by use of dynamic stage and discharge data obtained in August 1976. The water temperature changed as much as 4.4 C while passing through a 17-mile part of the reach and the temperature model was capable of predicting these changes with a root-mean-square error of 0.72 C in July and 0.65 C in August 1976. (Woodard-USGS)
W79-07936

TECHNIQUE FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS IN DELAWARE,
Geological Survey, Towson, MD. Water Resources Div.
R. H. Simmons, and D. H. Carpenter.
Geological Survey Water-Resources Investigations 78-93 (open-file report), September 1978. 69 p, 3 fig, 3 plates, 5 tab, 15 ref.

Descriptors: *Delaware, *Flood forecasting, Flood recurrence interval, *Flood peak, *Regression analysis, Streamflow, Peak discharge, Natural streams, Watersheds(Basins), Analytical techniques, Flood frequency, Gaging stations, Model studies, Rainfall-runoff relationships, Equations, Evaluation, Ungaged streams, Basin characteristics.

A flood-estimating method is presented which applies to drainage basins in Delaware without urban development and covers selected recurrence intervals from 2 to 100 years. The method was developed by multiple-regression techniques. The State is divided into two regions and sets of equations for calculating peak discharges based on physical basin characteristics are provided for each region. The boundary between regions generally corresponds with the division between the Piedmont and Coastal Plain provinces. In the northern region, flood peaks were related to drainage area, slope, storage, forest cover, and two composite soil categories. Standard errors of estimate for the regression equations in the northern region ranged from 30 to 39 percent. For the southern region, the standard errors of estimate varied from 38 to 40 percent. Without using the two soil parameters in the southern region, the standard errors of estimate varied from 57 to 70 percent. Annual flood peaks, basin characteristics, and flood-frequency distributions are tabulated for the 60-gaged sites used in

the regression analysis. At 23 of these sites, a rainfall-runoff model generated additional flood-peak data which were used in defining the flood-frequency distributions. (Woodard-USGS)
W79-07942

THE USE OF A SIMPLE MODEL AND UNCERTAINTY ANALYSIS IN LAKE MANAGEMENT,
Michigan State Univ., East Lansing. Dept. of Resources Development.
K. Reckhow.
Water Resources Bulletin, Vol. 15, No. 3, p 601-611, June 1979. 3 fig, 3 tab, 8 ref.

Descriptors: *Uncertainty, *Lakes, *Management, *Water quality, *Mathematical models, Phosphorus, Nonlinear regression analysis, Estimating, Confidence limits, Prediction, Nutrient budget, Sampling design, Data analysis, New Hampshire, Equations, Systems analysis.

A simple, black-box lake model was developed for phosphorus, using nonlinear regression analysis on a data base of north temperate lakes. The uncertainty associated with the model was then combined with the parameter uncertainty and the independent variable uncertainty to provide an estimate of the confidence limits associated with a predicted value. The prediction uncertainty is often neglected, yet it is an important measure of the usefulness of a model. Prediction uncertainty reflects the modeler's confidence in the model, and it should be used by a decision maker as a weight indicating the value of the model prediction. A procedure is outlined that combines lake modeling and uncertainty analysis for use in lake quality assessment and lake management. An example is provided illustrating the use of this procedure in nutrient budget sampling design, data analysis, and the evaluation of lake management strategies for a 208 program in New Hampshire. (Bell-Graf-Cornell)
W79-07996

ANALYSIS OF CLOSED CONDUIT IRRIGATION SYSTEM AND ITS SUBDIVISION,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
D. Karmeli, and G. Oron.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol. 105, No. IR2, p 187-196, June 1979. 2 fig, 1 tab, 15 ref.

Descriptors: *Irrigation systems, *Closed conduits, *Mixed integer programming, *Nonlinear programming, *Cost minimization, Optimization, Subdivisions, Constraints, Mathematical models, Equations, Systems analysis, Pipes, Objective function, Methodology, Water distribution(Applied).

An analysis of closed conduit irrigation systems towards minimal system cost is presented, using a nonlinear mixed integer programming optimization procedure. Emphasis is on the subdivision of the system into subunits and the relationship between the subunits, design parameters and system cost. The variables defined in the objective function and constraints are the number of manifold and lateral outlets, sizes of mains, submains, supplies, manifolds and laterals. An application example is given in which the subdivision for an irrigation system of a specific field is analyzed. (Bell Graf-Cornell)
W79-08000

6B. Evaluation Process

LEVELS OF ANALYSIS IN COMPREHENSIVE RIVER BASIN PLANNING,
Utah Water Research Lab., Logan.
D. T. Larson, L. D. James, and K. R. Kimball.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 273. Price codes: A06 in paper copy, A01 in microfiche. Utah Water Resources Planning Series, UWRL/P-79/05, May 1979. 110 p, 7 fig, 10 tab, 2 append. OWRT C-7161 (No. 6212) (1), 14-34-0001-6212

Descriptors: *Making, Political, River Basin, UI

Since every w has two or m solved. Equitab the reasons for between decisio impacted in social, cultural levels ranging decisions generat interactive procece in ways out point. The obje ze this proces institutional m ences among le tion views diff various levels pective differ action and temp resources plan and a compute for the Unintah provide backgr to effectively principles of la decision makin causes of levels quences of ind consequences of idual values d social values. efficient in action makers at plans. Nine rec improve water tive, nonlinear v
W79-07577

WATER-BASED FOR RECREATION FEDERAL LO
Purdue Univ., and Natural Res I. T. O'Leary, a Water Resourc 188, February IND (2).

Descriptors: *W pects, Econom Swimming, Wa

The water-base units at state plicants identi groups is exam participant groups economic char groups of highl at both types social action sy tional social sy standing of leisu
W79-07580

WATER IN TH
Geological Sur Div.
G. E. Ferguson Geotimes, p 27-

Descriptors: *I ment, *Data Cooperatives, logical Survey,

Although water one of the major Survey for m received no dir the West, and found in the a which establish of the West ha they were barr idors. Howeve ishment-the Su

Evaluation Process—Group 6B

Descriptors: *River basin, *Planning, Decision making, Political aspects, Social values, Colorado River Basin, Uintah Basin.

Since every water resources management choice has two or more sides, differences must be resolved. Equitable resolution requires understanding the reasons for the differences. The differences are between decisions made by individuals and groups impacted in physical-environmental, economic, social, cultural, and political dimensions and at levels ranging from local to international. The decisions generate additional impacts; and the interactive process changes water management practice in ways outside the control of any one decision point. The objective of this study is to conceptualize this process in a way that will help establish institutional mechanisms for reconciling differences among levels of analysis. The conceptualization views differences in the choices being made at various levels of analysis as associated with perspective differences having value, jurisdiction, action and temporal elements. The history of water resources planning in the Colorado River Basin and a computerized simulation of water planning for the Uintah Basin are used to identify and provide background for analyzing 20 major obstacles to effective water resources planning. The principles of logic as applicable to rationality in decision making are used to identify two root causes of levels' conflicts. These are that the consequences of individual actions do not sum to the consequences of an entire program and that individual values do not aggregate linearly in forming social values. Consequently many actions are not efficient in achieving preferred values, and decision makers are not able to implement desired plans. Nine recommendations are made on how to improve water resources planning in an interactive, nonlinear world.

W79-07577

WATER-BASED ACTIVITY INVOLVEMENT FOR RECREATION CONSUMERS AT STATE, FEDERAL, LOCAL, OR PRIVATE FACILITIES. Purdue Univ., Lafayette, IN. Dept. of Forestry and Natural Resources. J. T. O'Leary, and G. Pate. Water Resources Bulletin Vol. 15, No. 1, p 182-188, February 1979. 3 tab, 16 ref. OWRT A-051-IND (2).

Descriptors: *Water sports, *Recreation, Social aspects, Economics, Fishing, Hunting, Camping, Swimming, Water skiing, Boating.

The water-based activity involvement of participants at state and federal and local and private facilities identified by using participation rate groups is examined. No differences between participant groups within activities based on socioeconomic characteristics were found. However, groups of highly active individuals were identified at both types of properties. It is suggested that social action system variables be added to traditional social aggregate variables to assist the understanding of leisure involvement.

W79-07580

WATER IN THE WEST. Geological Survey, Reston, VA. Water Resources Div. G. E. Ferguson. Geotimes, p 27-29, March 1979.

Descriptors: *History, *Water resources development, *Data collections, Federal government, Cooperatives, Cost sharing, Reviews, *US Geological Survey, *Water resources division.

Although water-resources investigation has been one of the major activities of the U.S. Geological Survey for many decades, water as a resource received no direct attention in 4 early surveys of the West, and the term 'water' cannot even be found in the act of Congress of March 3, 1879, which established the Survey. Several major rivers of the West had been surveyed but only because they were barriers in East-West transportation corridors. However, in 1888-9 years after its establishment—the Survey brought together 14 carefully

chosen men led by Frederick H. Newell, at a camp near Embudo, N. Mex., to select and provide training in methods, instruments, and equipment needed for systematic stream gaging. A Senate resolution of that year, directing the Survey to investigate the practicality of storing water in the arid regions, required a knowledge of streamflow. Although others had collected various types of records of stream discharge at various places in the United States and in foreign countries, the Survey developed techniques and standards that were widely accepted, and its stream-gaging network grew steadily, both in size and in geographic coverage. Today the Survey's Chief Hydrologist, Joseph S. Cragwall, Jr., directs an organization of about 4,100 full- and part-time employees, located in 46 district offices administered by 4 regional headquarters. Congressional appropriations fund slightly more than half the water-resources programs, about 580 State and municipal agencies fund more than a quarter, and 27 other Federal agencies provide money for the rest. (Woodard-USGS) W79-07696

ENERGY DEVELOPMENT SCENARIOS AND WATER DEMANDS AND SUPPLIES—AN OVERVIEW. Geological Survey, Reston, VA. Water Resources Div.

F. A. Kilpatrick. Geological Survey open-file report 77-697, August 1977. 14 p, 10 fig, 3 tab, 16 ref.

Descriptors: *Water demand, *Available water, *Mining, *Energy, *Central U.S., Coal mines, Oil shales, Transportation, Slurries, Pipelines, Evaluation, Missouri River, Colorado River basin, *Energy development.

On the basis of average mean annual flows, ample water exists in the upper Missouri River basin for energy development. The lack of storage and diversion works upstream as well as State compacts preclude the ready use of this surplus water. These surplus flows are impounded in mainstream reservoirs on the Missouri downstream from coal mining areas but could be transported back at some expense for use in Wyoming and North Dakota. There are limited water supplies available for the development of coal and oil shale industries in the upper Colorado River Basin. Fortunately oil shale mining, retorting and reclamation do not require as much water as coal conversion; in-situ oil shale retorting would seem to be particularly desirable in the light of reduced water consumption. Existing patterns of energy production, transport, and conversion suggest that more of the coal to be mined out West is apt to be transmitted to existing load centers rather than converted to electricity or gas in the water-short West. Scenarios of development of the West's fossil fuels may be overestimating the need for water since they have assumed that major conversion industries would develop in the West. Transport of coal to existing users will require all means of coal movement including unit trains, barges, and coal slurry pipelines. The latter is considered more desirable than the development of conversion industries in the West when overall water consumption is considered. (Woodard-USGS) W79-07700

PLANS FOR WATER DATA ACQUISITION BY FEDERAL AGENCIES THROUGH FISCAL YEAR 1980. Geological Survey, Reston, VA. Water Resources Div. Geological Survey Office of Water Data Coordination report, January 1979. 78 p, 2 append.

Descriptors: *Data collections, *Programs, *Federal government, *Water resources development, Water supply, Water quality, Water utilization, Water pollution control, Land use, Urbanization, Flood control, Available water, Surface waters, Groundwater, Department of Agriculture, Department of Commerce, Department of Defense, Department of Energy, Department of Housing and Urban Development, Department of Interior, Department of Transportation, Council on Environmental Quality, Environmental Protection

Agency, International Boundary and Water Commission, International Joint Commission, Nuclear Regulatory Commission, Tennessee Valley Authority, Water Resources Council.

This report was prepared by the Office of Water Data Coordination (OWDC), U.S. Geological Survey, in partial response to requirements of Bureau of the Budget (now Office of Management and Budget (OMB)) Circular A-67 (appendix A), which sets forth guidelines for the coordination of certain water-data acquisition activities by Federal agencies. The report was prepared in lieu of the customary annual 'Federal Plan for the Acquisition of Water Data.' Included are statements on Federal agencies' current water-data programs, plans and needs for water data through fiscal year (FY) 1980, and longer range water-data needs. The agency program summaries generally indicate that for FY 1980 most Federal programs for water-data collection will remain at approximately the same level of funding as for FY 1978 and 1979. Foremost among agencies' current needs are additional data on water quality, water use, and surface-water resources. (Woodard-USGS) W79-07704

VOLUME III. THE WETLANDS/EDGES PROGRAM. RESEARCH ON THE CHESAPEAKE BAY TO PROVIDE A KNOWLEDGE BASE FOR PHYSICAL ALTERATIONS OF THE EDGES OF THE CHESAPEAKE BAY. Chesapeake Research Consortium, Inc., Baltimore, MD.

For primary bibliographic entry see Field 6G. W79-07724

NATURAL RESOURCES OF COASTAL WETLANDS IN NORTHERN SANTA BARBARA COUNTY. San Diego State Univ., CA. Center for Regional Environmental Studies. For primary bibliographic entry see Field 2L. W79-07728

DEVELOPER'S HANDBOOK. Connecticut Dept. of Environmental Protection, Hartford. Coastal Area Management Program. A. Carroll. 1972. 60 p.

Descriptors: *Permits, *Regulation, *Wetlands, *Quality control, Dredging, Burning, Air pollution, Water pollution, Planning, Septic tanks, Water supply, Road design, Construction, Landscaping, Aesthetics.

The handbook is designed to help make the legal requirements for permits for environmental change more manageable to developers and to provide some basic information and advice on subdivision planning. The major natural systems and resources are briefly explained, and the opportunities and limitations they impose on development are summarized. A system of evaluating the characteristics of potential development sites is outlined and regulatory programs at the Connecticut Department of Environmental Protection with which developers may have to concern themselves are covered. (Bollinger-Mass) W79-07735

ANALYSIS OF ECONOMIC EFFECTS OF WATER SURFACE ELEVATIONS ON U.S. SHORELINE OF LAKE CHAMPLAIN, NEW YORK AND VERMONT. URS/Madigan-Praeger, Inc., New York. Prepared for the International Joint Commission, International Champlain-Richelieu Board, August 31, 1977. 215 p.

Descriptors: *Lake Champlain, *Water level fluctuations, *Reservoir management, *Estimated benefits, Wetlands, Marsh plants, Water levels, Marsh management, Economic impact, Evaluation, Economic prediction, Flood damage, Damages.

The objective was to develop the net benefits of the proposed regulation of the lake level by the use

Field 6—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

of three proposed structural alternatives. The net benefits are obtained by subtracting the estimated damages with structural regulation from the estimated damages with regulation; the difference is considered to be the benefits of the scheme under consideration. Physical damages realized due to the high water condition would include costs for those structures with which the flood waters came into direct contact, i.e., homes, roads, furnishings. Non-physical damages would include costs for inconvenience due to flood occurrence, i.e., time lost, clean-up costs, wages lost from work. Adverse effects associated with extreme low-water conditions include exposed water supply intakes, loss of boat dock use, and exposure of unsightly lake bottom. The present wetland ecosystem, however, is dependent upon fluctuating water levels with periodic highs and lows. High waters flood out some of the emergents which sometimes form too dense or solid stands. It is particularly useful in the natural control of cattails and buttonbush. (Steiner-Mass)
W79-07744

FIRST ORDER ESTIMATES OF ENERGY REQUIREMENTS FOR POLLUTION CONTROL, Development Sciences, Inc., Sagamore, MA. J. L. Barker, K. Maddox, J. D. Westfield, and D. Wilcock.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-278 274. Price codes: A05 in paper copy, A01 in microfiche. Report EPA-600/7-78-022, 1978. 88 p., 4 fig, 31 tab, 66 ref, 2 append.

Descriptors: *Cost analysis, *Pollution abatement, *Water pollution control, *Air pollution, *Thermal pollution, Industrial wastes, Energy, Municipal wastes, Powerplants, Fuels, Operating costs, Operation and maintenance, Waste water treatment.

A cost analysis of the pollution controls required for stationary point sources included a cost estimation of controls for water pollution from powerplants, factories, refineries, municipal waste water treatment plants, and certain air pollution sources. Results of the study indicated that in 1977, a total of 1,553 trillion Btu of energy was required to control both water and air pollution from industrial and municipal sources. In 1983, a total of 3,075 trillion Btu is estimated for pollution abatement. The sources of these energy requirements include: energy for operation of control devices such as fans, pumps, and reheaters; the additional fuel requirement for processes where pollution abatement techniques degrade the efficiency of the process; the energy required for the production, transport, and installation of the pollution control equipment; and the energy expended in producing and transporting pollution control material such as limestone and chlorine. About 80% of the total energy requirements may be attributed to the direct utilization of fuel or electricity to operate pollution control equipment. The largest energy demands are required for control of industrial air pollution sources, followed by the energy requirements for controlling industrial water pollution. The third highest demand is the abatement of air pollution from powerplants. The report does not incorporate pollution controls for mobile pollution sources and non-point sources. (Lisk-FRC)
W79-07798

GUIDANCE ECONOMIC ANALYSIS FOR THE CONCRETE PRODUCTS INDUSTRIES. Environmental Protection Agency, Washington, DC.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-273 471. Price codes: A05 in paper copy, A01 in microfiche. Report EPA 440/2-77-016, 1977. 90 p., 54 tab.

Descriptors: *Economic impact, *Federal Water Pollution Control Act, *Industrial water, *Waste water treatment, *Concrete technology, Capital costs, Operating costs, Prices, Employment.

The economic impact of the application of alternative effluent limitation guidelines and standards of performance to be established by sections 304(b)

and 306 of the Federal Water Pollution Control Act, as amended, was analyzed for the concrete products industry. Existing and potential wastewater treatment control methods are surveyed. Investment and operating costs associated with various alternative control and treatment technologies are presented. Also, the broader economic effects of alternative approaches are examined. The effects on product price, unemployment and the continued viability of affected plants, and competitive effects such as the effect on foreign trade, are investigated. (Small-FRC)
W79-07803

PROMISING STRATEGIES FOR RESERVING INSTREAM FLOWS.

Dewsnup (Richard L.)/Dallin W. Jensen, Salt Lake City, UT.

For primary bibliographic entry see Field 6A.
W79-07878

THE ECONOMIC IMPACT OF ALTERNATIVE CYANIDE STANDARDS IN ILLINOIS,

IIT Research Inst., Chicago, IL.

For primary bibliographic entry see Field 6E.
W79-07885

CONSERVATION DISTRICTS AND 208 WATER QUALITY MANAGEMENT-NON-POINT SOURCE IDENTIFICATION AND ASSESSMENT, SELECTION OF BEST MANAGEMENT PRACTICES, MANAGEMENT AGENCIES, REGULATORY PROGRAMS,

National Association of Conservation Districts, Washington, DC.

For primary bibliographic entry see Field 4A.
W79-07886

EXPANDED OFFSHORE LEASING AND THE MANDATES OF NEPA,

For primary bibliographic entry see Field 5B.
W79-07898

WATER LAW PROBLEMS OF SOLAR HYDROGEN PRODUCTION,

For primary bibliographic entry see Field 6E.
W79-07901

RECENT CONGRESSIONAL ACTION ON OUTER CONTINENTAL SHELF OIL AND GAS DEVELOPMENT,

For primary bibliographic entry see Field 6E.
W79-07906

OPTIMUM ALTERNATIVES FOR CONTROLLING COMBINED SEWAGE OVERFLOWS-A CASE STUDY,

Barr Engineering Co., Minneapolis, MN.

I. Yomtovian.
Water Resources Bulletin, Vol. 15, No. 3, p 628-643, June 1979. 5 fig, 2 tab, 6 ref.

Descriptors: *Sewage systems, *Sewage overflow, *Methodology, *Effects, *Water quality, *Economic efficiency, *Combined sewers, Mississippi River, Optimization, Storm sewers, Water pollution control, Waste water disposal, Treatment facilities, Hydrology, Bypasses, Cost effectiveness.

Frequent high quantity overflows of combined sewage entering the Mississippi River near the city of Red Wing, Minnesota, have degraded water quality and caused concern among federal and state environmental agencies. The city of Red Wing was required to conduct a comprehensive waste control study, as part of the sewer system Construction Grant (Section 201 of PL 92-500), to identify alternative waste control and treatment measures and to recommend the optimum combination of alternatives in terms of both cost and waste control effectiveness. The study involved these basic steps: determination of present and future (year 2020) sanitary flow rates and volumes, storm runoff discharges, frequencies and volumes, and combined sewage bypass volumes; identification of alternative waste control measures; elimina-

tion of unfeasible alternatives; detailed analysis of the hydrologic, economic, and waste control feasibility of the promising alternatives; selection of the optimum combination of alternative waste control measures to satisfy the study objectives, and determination of construction priorities of the optimum control measures. Because of an uncertain budget and undetermined conditions of state and federal assistance, the city has not yet selected the optimum waste control measure for its needs. When the decision-making process between representatives of the city and the state commences, the optimum combination of waste control alternatives can be easily identified using results of this study. (Bell Graf-Cornell)
W79-07997

COST ANALYSIS OF WATER AND WASTE WATER TREATMENT PROCESSES IN DEVELOPING COUNTRIES,

Universidade Federal da Paraíba (Brazil).

M. I. Muiga, and G. W. Reid.

Water Resources Bulletin, Vol. 15, No. 3, p 838-852, June 1979. 1 fig, 5 tab, 17 ref.

Descriptors: *Water treatment, *Waste water treatment, *Cost analysis, *Predictive equations, *Regional models, *Planning, *Developing countries, Socio-economic indicators, Environment, Technology, Africa, Asia, Latin America, Construction costs, Operation and maintenance, Sand filters, Stabilization lagoon, Aerated lagoons, Activated sludge, Trickling filters, Water quality, Design capacity, Population, Systems analysis.

Mathematical modeling techniques have been used to develop predictive equations for the cost of water and waste water treatment processes in developing countries utilizing socio-economic, environmental, and technological indicators. Predictive equations were developed for each of the three regions (Africa, Asia, and Latin America) for construction, operation and maintenance costs of slow sand filter, rapid sand filter, stabilization lagoon, aerated lagoon, activated sludge, and trickling filter. Data analysis indicated that cost of water treatment processes is a function of technological indicator (percentage of imported materials), population, and the design capacity. The variables which gave the best correlation for waste water treatment cost were population, design flow, and the percentage of imported waste water disposal materials. (Bell-Graf-Cornell)
W79-07999

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ASSESSMENT OF CIVIL MONETARY PENALTIES FOR WATER POLLUTION: A PROPOSAL FOR SHIFTING THE BURDEN OF PROOF REGARDING DAMAGES,

For primary bibliographic entry see Field 6E.
W79-07907

PROTECTING MASSACHUSETTS WETLANDS,

Suffolk Univ., Boston, MA.

For primary bibliographic entry see Field 6E.
W79-07908

6D. Water Demand

WATER REUSE AND RECYCLING, VOLUME I: EVALUATION OF NEEDS AND POTENTIAL,

Culp/Wesner/Culp, Santa Ana, CA.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 283. Price codes: A09 in paper copy, A01 in microfiche. Office of Water Research and Technology Report No. OWRT/RU-79-1, April 1979. 194 p., 22 fig, 37 tab, 67 ref. OWRT R-0088 (No. 7804) (1).

Descriptors: *Water reuse, *Recycling, *Hydrologic data, *Water quality, *Water quality control, *Water requirements, *Planning, Industrial water,

Agriculture, supply, Water

Estimates of and recycling are presented. Water Resources National Water basic data availability, and estimates derive partment of the Federal Energy Reg. of Energy), electric plan reuse facilities. Water quality following water: agriculture, steam elect other industry supplies are requirements major water regions and 106 subregion for reuse and reuse are ta tions for l cluded. (Da W79-07501

ENERGY WATER OVERVIEW

Geological Div.

For primary W79-07700

REPORT OF DELAWARE

MEMBER 1 Geological Div. and G Resources I

F. T. Schae Geological

1978. 105 p.

Descriptors

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leases, Estu ing, *Delawa

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HYDROLOGICAL

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J. E. Moore

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and Future,

Agriculture, Regions, Irrigation, Cooling, Water supply, Water supply development.

Estimates of the potential for waste water reuse and recycling in the United States in 1985 and 2000 are presented. Information developed by the U.S. Water Resources Council (WRC) for the Second National Water Assessment was used to supply the basic data for water supply, water needs and availability, and waste water discharges. Recycling estimates derived from studies by the WRC, the Department of Commerce, the Bureau of Mines, and the Federal Power Commission (now the Federal Energy Regulatory Commission in the Department of Energy), are presented for industries and steam electric plants. Existing and proposed waste water reuse facilities are reported for each WRC Region. Water quality requirements are described for the following potential reusers of reclaimed waste water: agricultural irrigation, landscape irrigation, steam electric cooling, industrial cooling, and other industrial uses. Although the Nation's water supplies are generally sufficient to meet the requirements for all beneficial purposes, there are major water supply problems in most of the 21 regions and severe local problems in many of the 106 subregions. Waste water discharges available for reuse and withdrawals capable of waste water reuse are tabulated for each of the 21 WRC Regions for 1975, 1985 and 2000. Regional evaluations for Lower Colorado and California are included. (Davison-IPA)
W79-07501

ENERGY DEVELOPMENT SCENARIOS AND WATER DEMANDS AND SUPPLIES—AN OVERVIEW.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 6B.
W79-07700

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1976 – NOVEMBER 30, 1977.
Geological Survey, Reston, VA. Water Resources Div. and Geological Survey, Milford, PA. Water Resources Div.
F. T. Schaefer, and R. E. Fish.
Geological Survey Delaware River Master report, 1978. 105 p, 6 fig, 2 plates, 20 tab, append.

Descriptors: *Delaware River, *Watershed management, *Available water, *Water delivery, *Water quality, Reservoir storage, Reservoir releases, Estuaries, Saline water intrusion, Monitoring, *Delaware River Master, Annual report.

This annual report of the River Master of the Delaware River is for the year December 1, 1976, to November 30, 1977. In terms of water supply, the year was above normal. The discharge of the Delaware River at Montague, New Jersey, adjusted for diversions and changes in reservoir storage, was 28 percent above median and the ninth highest since 1940. Total combined storage in Pepacton, Cannonsville, and Neversink Reservoirs was 87.9 percent of capacity on December 1, 1976, as compared with 95.9 percent a year earlier. This was the third highest total storage at the beginning of any report year since the construction of the reservoirs. Diversions for water supply for New York City and releases to maintain the flow of the Delaware River at Montague were made under the supervision of the River Master, as provided in the terms of the Amended Decree of the Supreme Court, June 7, 1954. Diversions through the Delaware & Raritan Canal in New Jersey did not exceed the limits imposed in the Decree. Data from the water-quality monitoring program carried out by the U.S. Geological Survey in the Delaware River Estuary are included. (Woodard-USGS)
W79-07702

HYDROLOGY.
Geological Survey, Reston, VA. Water Resources Div.
J. E. Moore.
In: Encyclopedia Britannica Yearbook of Science and Future, Earth Sciences, p 316-317, 1979.

Descriptors: *Hydrology, *Conferences, *Water quality, *Water supply, Surface waters, Groundwater, Water pollution, Waste disposal, Floods, Flood damage, Flood plains, Water policy, Water conservation, Sewage treatment, Symposia topics.

This paper briefly discusses several major technical symposia concentrated on topics of concern during 1978. The National Water Well Association and the U.S. Environmental Protection Agency sponsored the National Ground Water Quality Symposium in Minneapolis, Minn., to discuss groundwater pollution and ground-water protection policies. A two-day symposium at the annual meeting of the American Chemical Society in Miami Beach, Fla., highlighted past and present research in water chemistry and effects of radioactive waste disposal on water resources. At the American Water Resources Association meeting in Florida three symposia dealt with the interrelationship of energy, environment, and economics. (Woodard-USGS)
W79-07709

PROMISING STRATEGIES FOR RESERVING INSTREAM FLOWS.
Dewsnup (Richard L.)/Dallin W. Jensen, Salt Lake City, UT.
For primary bibliographic entry see Field 6A.
W79-07878

MUNICIPAL AND INDUSTRIAL WATER CONSERVATION - THE FEDERAL GOVERNMENT COULD DO MORE.
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 6E.
W79-07881

WATER RESOURCES PLANNING, MANAGEMENT, AND DEVELOPMENT: WHAT ARE THE NATION'S WATER SUPPLY PROBLEMS AND ISSUES.
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 6E.
W79-07882

CONSERVATION DISTRICTS AND 208 WATER QUALITY MANAGEMENT-NON-POINT SOURCE IDENTIFICATION AND ASSESSMENT, SELECTION OF BEST MANAGEMENT PRACTICES, MANAGEMENT AGENCIES, REGULATORY PROGRAMS.
National Association of Conservation Districts, Washington, DC.
For primary bibliographic entry see Field 4A.
W79-07886

WATER RIGHT LAWS AS THEY AFFECT LAND ACQUISITION AND CONSTRUCTION.
Montana State Univ., Bozeman. Center for Interdisciplinary Studies.
For primary bibliographic entry see Field 4A.
W79-07891

PROBLEMS AFFECTING USEFULNESS OF THE NATIONAL WATER ASSESSMENT WATER RESOURCES COUNCIL.
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 4A.
W79-07893

UPDATING GROUNDWATER LAW: NEW WINE IN OLD BOTTLES.
For primary bibliographic entry see Field 6E.
W79-07894

WATER LAW PROBLEMS OF SOLAR HYDROGEN PRODUCTION.
For primary bibliographic entry see Field 6E.
W79-07901

ACREAGE AND RESIDENCY LIMITATIONS IN THE IMPERIAL VALLEY: A CASE STUDY IN NATIONAL RECLAMATION POLICY.

For primary bibliographic entry see Field 6E.
W79-07902

CAPPAERT V. UNITED STATES: A DEHYDRATION OF PRIVATE GROUNDWATER USE.
For primary bibliographic entry see Field 6E.
W79-07904

6E. Water Law and Institutions

OVERCOMING LEGAL AND INSTITUTIONAL BARRIERS TO PLANNED REUSE OF WATER IN THE COLORADO RIVER BASIN.
Denver Research Inst., CO. Industrial Economics Div.

J. G. Milliken, L. C. Lohman, A. S. Trumbly, and L. Roll.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 270, Price codes: A10 in paper copy, A01 in microfiche. Office of Water Research and Technology Report No. OWRT/RU-79/3, April 1979. 211 p, 17 fig, 7 tab, 333 ref. OWRT R-0050 (No. 7816) (1).

Descriptors: *Water reuse, *Institutional constraints, *Policy constraints, *Legal aspects, *Social aspects, *Economic impact, *Planning, Impaired water use, Water allocation (Policy), Water policy, Water resources development, Water utilization, Colorado River Basin.

Research was undertaken to identify and analyze the severity of the legal, institutional, political, and economic obstacles to planned water reuse in the Colorado River Basin, to analyze and assess methods or strategies that aid in overcoming these obstacles, and to develop conclusions on them for the promotion of greater planned reuse within the Basin. Nonagricultural reuse and consumptive reuse of low quality water are emphasized. Barriers to reuse found in interstate and state-specific water allocation law, and in Federal and State environmental laws were identified through legal research; comprehensive interviews with water management officials in the Basin and a document review identified the institutional and political obstacles; available literature was used to document societal positions on different types of water reuse; and the concerns of water reusers were obtained from interviews and documentation. Five case studies of various attempts to reuse water in the Basin were conducted to establish the interaction between reuse barriers and incentives. The strategies found most likely to promote reuse include creative tactics by prospective reusers, strategic actions by State water allocators, and changes in statutes; institutional conflicts were reduced by making benefits visible to parties in conflict. (Davison-IPA)
W79-07502

FRESHWATER USE CUSTOMS ON GUAM—AN EXPLORATORY STUDY.
Guam Univ., Agaña. Water Resources Research Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 299, Price codes: A08 in paper copy, A01 in microfiche. Publication No. 8, 1979. 146 p, 37 fig, 78 ref, 3 append. Stephenson, R.A., Editor. OWRT A-009-GUAM (1), 14-34-0001-8012, 9012.

Descriptors: *Social aspects, Attitudes, History, *Guam, Mariana Islands, Chamorro.

Traditional Chamorro freshwater use customs on Guam still exist, at least in the recollections of Chamorros above the age of 40, if not in actual practice in the present day. Such customs were analyzed in both their past and present context, and are documented. Archaeological evidence suggests a close correspondence between prehistoric settlement patterns and freshwater sources. It is speculated that pre- and post-contact Chamorro living in the northern plateau of Guam may have been involved in reciprocal trading arrangements with sites that had fresh water readily available during dry periods. The perception of freshwater in the Chamorro language context is shown to be

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changing. Ethnohistorical studies indicate that availability of freshwater to meet the needs of Guam's people has always been a problem. Socio-cultural studies, as gleaned from a questionnaire, on the other hand, suggest that Chamorros over the age of 40 do not recall problems for the most part in their villages of residence and traditional water sources by locally derived names, names that are not often found on present day maps of Guam. Further studies of freshwater use customs on Guam are recommended.
W79-07569

COLORADO GROUND WATER UP FOR GRABS.

Water Well Journal, Vol. 33, No. 6, p 62-74, June, 1979.

Descriptors: *Water rights, *Colorado, *Ground water resources, *Appropriation, Law, Prior appropriation, Legal aspects, Economic feasibility.

The Colorado Constitution established the doctrine of prior appropriation meaning that the first person to claim water and put it to beneficial use has rights to that water perpetually. The 1969 Colorado Water Rights Act states that all water originating in the state, whether surface or underground, is subject to appropriation. However, a new law called SB213 makes land ownership a prerequisite for tapping, non-tributary or bedrock ground waters. Three groups are filing claims to Colorado's unappropriated ground water. They intend to use the water for: large-scale real estate development; trans-mountain diversion of water from western to eastern Colorado; and saltwater fish farms. Even if the claims are granted, it may not be economically feasible to recover the water due to high drilling, pumping, and reclamation costs and water quality problems. (Purdin-NWVA)
W79-07631

IMPACT OF THE LAW REGULATING DRINKING WATER ON WATER RESOURCES MANAGEMENT.

Connecticut University, Storrs, Department of Business Environment and Policy.
M. M. Huffmire.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 762. Price codes: A02 in paper copy, A01 in microfiche. Connecticut University, Storrs, Institute of Water Resources. Research Project Technical Completion Report, 1979. 10 p. 3 ref. OWRT A-079-CONN(1), 14-34-0001-9007.

Descriptors: *Ground water, *Aquifers, *Land use, *Water law, Economics, Connecticut, *Water resources management, *Drinking water supplies, *Safe drinking water act, *Water quality protection, *Investor-owned water companies, *Surplus land holdings, Moratorium on land sales, Surface water impoundments, Legal implications.

Costs of compliance with minimum standards for water quality in Connecticut mandated by the Safe Drinking Water Act have led some investor-owned water utility companies to attempt to dispose of what they argue are surplus land holdings. There is presently a moratorium on the sale of these lands but the question arises as to what will eventually be done with property. The state is considering whether it should grant special assistance to the investor-owned water utility companies in meeting the costs of complying with the Safe Drinking Water Act requirements and what form that aid should take. However, if present and anticipated increases in costs caused by the Safe Drinking Water Act are not eventually passed on to the consumers in the rate base and new methods of funding will be used to insure continued low cost of the resource, demand will be further divorced from supply and market mechanisms will be rendered ineffective. Adequate protection of aquifers and surface water impoundments requires not only continued water company ownership of the land covered by the moratorium, but also that relevant lands within the state are regulated as part of a comprehensive program for protecting present and future drinking water supplies. Where ground

water and surface water rights are in conflict, a comprehensive management system should be adopted to establish an order of preferred uses and optimize water availability by providing for conjunctive use of ground water and surface water.
W79-07716

EXISTING STATE AND LOCAL WETLAND SURVEYS (1965-1975). VOLUME II: NARRATIVE.

Martel Labs., Inc., Baltimore, MD.
For primary bibliographic entry see Field 7B.
W79-07726

ASPECTS OF STATE-WIDE EMERGENCY RESPONSE PROGRAMS FOR MUNICIPAL WASTEWATER TREATMENT FACILITIES PROGRAM.

Wiley and Wilson, Inc., Lynchburg, VA.
For primary bibliographic entry see Field 5G.
W79-07797

GUIDANCE ECONOMIC ANALYSIS FOR THE CONCRETE PRODUCTS INDUSTRIES.

Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 6B.
W79-07803

NEW ONTARIO POLICY FOR LOW COST ALTERNATIVES TO COMMUNAL WATER AND SEWAGE TREATMENT.

Ontario Ministry of the Environment (Toronto).
G. Mierzynski.
In: Proceedings of the Seminar on Current Approaches in Wastewater Treatment, April 5, 1978, Ontario Ministry of Health Laboratories, Toronto, Canada, p 1-5 (1978).

Descriptors: *Administration, *Canada, *Septic tanks, *Water wells, *Rural areas, Community development, Cost analysis, Grants, Treatment facilities, Water supply, Waste water treatment, Waste water disposal, Municipal wastes, Domestic wastes.

The Ontario Ministry of the Environment has adopted a policy of providing grants to municipalities for repairing or renewing private systems in defined problem areas where command systems are not cost effective. The average cost per home for communal water and waste treatment facilities, based on 1977 statistics, was \$5,500 for water systems and \$6,600 for sewage systems. For individual private systems, the costs are about \$1,500 for a well and \$2,500 for a septic tank and tile field. The new policy extends only to the renewal or repair of existing systems; however, the policy may be extended to new systems in an existing structure located a significant distance from the solution to the water or waste treatment problem and not located in an area of potential growth. The policy will also apply to unorganized communities and small communities with little growth potential which qualified under previous policies. New and novel systems of treatment should be considered along with conventional systems, and combinations of private and communal systems may be possible. (See also W79-07842) (Lisk-FRC)
W79-07843

HIGHLIGHTS OF THE CLEAN WATER ACT OF 1977.

For primary bibliographic entry see Field 5D.
W79-07874

FEDERAL RESERVED WATER RIGHTS SINCE PLLRC.

Wyoming Univ., Laramie.
F. J. Trelease.
Public Land and Resources Law Journal, Vol. 15, No. 2, p 218-36, 1978.

Descriptors: *Reservation doctrine, *Legislation, *Federal reservations, Federal government, Federal-state water rights conflicts, Federal jurisdiction, Prior appropriation, Water policy, Water control, Water law.

When the federal government withdraws a part of its land from the public domain and reserves it for a federal purpose, the government by implication reserves enough of the 'appurtenant' unappropriated water to accomplish the purpose of the reservation. This water right may lie dormant for years. If the government eventually exercises its reserved right, its priority relates not to the date of use but to the earlier date when the reservation was created. Since the investment and enterprise of the private water user are lost when the government takes the water, the federal reserved water rights are viewed by many as a serious threat to every title to water rights of every stream which touches a federal reservation. The history of the reserved water doctrine, the effects of Supreme Court decisions on the doctrine and the effect the Public Land Law Review Commission on the doctrine are examined. The threat the reserve doctrine poses to private users may be illusory since not a single case of the federal government destroying a private right has been reported. (Vloedman-Florida)
W79-07875

LAND APPLICATION OF WASTEWATER AND STATE WATER LAW: STATE ANALYSES VOLUME II.

Wisconsin Univ.-Madison. School of Law.
D. W. Large.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-286 975. Price codes: A09 in paper copy, A01 in microfiche. Report EPA-600/2-78-175, August, 1978, 197 p.

Descriptors: *Waste water disposal, *State governments, *Water rights, Legal aspects, Water policy, Judicial decisions, Riparian rights, Appropriation, Surface-groundwater relationships, Regulations.

This report's purpose was to: (1) define the legal questions which pertain to land application of wastewater in the context of private water rights law; (2) explain the riparian and appropriation theories; (3) identify the particular aspects of each theory that influence treatment system design and operation; and (4) analyze the private water rights laws of selected states in relationship to land application systems. Hostility to land application systems was not discovered in any of the states' laws analyzed. Occasional uncertainties existed in several states caused by the lack of statutes, regulations, or judicial decisions involving land application. The position of land application systems was strongest in the eastern riparian states. Probably the most favorable eastern states for the land application systems are Florida, Pennsylvania, and Ohio. Each of these states displays a receptiveness toward innovative water uses. The western appropriation states were generally less favorable to land application. This was primarily because the appropriation theory recognizes enforceable rights in all water types, whereas under the riparian theory, such rights are usually limited to watercourses. (Ewing-Florida)
W79-07876

FLOOD PLAIN DEVELOPMENT PRESSURES AND FEDERAL PROGRAMS-PART 1-CASE STUDY ANALYSIS AND RECOMMENDATIONS FOR THE '201' WASTEWATER TREATMENT WORKS PROGRAM.

Research Group, Inc., Atlanta, GA.
L. F. Dean.
EPA 130/1-79-001, May, 1979, 77 p.

Descriptors: *Floodplains, *Waste treatment, *Sewage treatment, *Regional analysis, Legal aspects, Administrative agencies, Administrative decisions, Federal government, Environmental effects, Environmental control, Land use.

Between October, 1977 and June, 1978, a study of floodplain development pressures and federal programs was carried out. Recommended are ways in which the federal Environmental Protection Agency (EPA) can reduce floodplain development pressures caused by the '201' Wastewater Treatment Works Program (WTWP). These recommendations to EPA are based on: (1) 31 case studies of floodplain development pressures in the midwest,

west, and southern offices and (4) major which can afford commendation development planning; (2) coo Federal insur agency coord impact; (4) d floodplain d study's results nities receiving information for the imple impact policies W79-07877

PROMISING INSTREAM

Dewsnup (R Lake City, U For primary W79-07878

DIFFUSE S CONSIDER

Council of S Available from Service, Spr Price codes: March 1977,

Descriptors: constraints, urds, Control Deterioration

The control tion, or diffu pressing env governments implementing fuse sources detailed expli tion is, or the source pollut Part two exp lating diffusi tion had not class. The C Pollution Co the diffuse s analyzed an tions for im programs. T cooperative take the lea stronger fed eral findi timing and d an appendix search agen (Coffey-Flon W79-07879

THE NATION GRAM REV ORDINANC ITS LAND

Florida Univ F. E. Malon Available from Service, Sp Price codes: Florida Sea Paper No. 3.

Descriptors: urance, *FI ing, Land Hazards, Re

In 1975, a m developed to the land ma of the Nation In 1976, the linked the fi the NFIP S

west, and southeast; (2) meetings with EPA regional offices; (3) interviews with federal officials; and (4) major decision points in the '201' WTWP which can affect floodplain development. The recommendations are: (1) identification of floodplain development pressures during Step 1 facility planning; (2) coordination between the EPA and the Federal Insurance Administration; (3) federal agency coordination for mitigation of floodplain impact; (4) definition of criteria and standards for floodplain development impacts. Although the study's results cannot be generalized to all communities receiving wastewater treatment facilities, the information obtained has important implications for the implementation of floodplain development impact policies by EPA. (Ewing-Florida) W79-07877

PROMISING STRATEGIES FOR RESERVING INSTREAM FLOWS.

Dewsnup (Richard L.)/Dallin W. Jensen, Salt Lake City, UT.

For primary bibliographic entry see Field 6A. W79-07878

DIFFUSE SOURCE POLLUTION: POLICY CONSIDERATIONS FOR THE STATES.

Council of State Governments, Washington, DC. Available from the National Technical Information Service, Springfield, VA 22161 as PB-274 493, Price codes: A04 in paper copy, A01 in microfiche. March 1977, 47 p.

Descriptors: *Water pollution sources, *Political constraints, *Regulation, Water pollution, Standards, Control, Monitoring, Institutional constraints, Deterioration.

The control of nonpoint sources of water pollution, or diffuse source pollution, is one of the most pressing environmental issues confronting state governments. The problems and opportunities of implementing successful programs to control diffuse sources are explored. The introduction gives a detailed explanation of what diffuse source pollution is, or the issues involved in managing diffuse source pollution, and the reasons for state concern. Part two explores state and federal programs regulating diffuse pollutions when diffuse source pollution had not yet been recognized as a pollution class. The Clean Air Act and the Federal Water Pollution Control Act, each recognizing a part of the diffuse source pollution issue, are extensively analyzed and criticized. Part three gives suggestions for implementing diffuse source pollution programs. The report calls for the states, in active cooperative partnership with local governments, to take the lead in meeting the problem to prevent a stronger federal role. Realistic and dependable federal finding of state programs and rational federal timing and dead lines are suggested. Included are an appendix suggesting future directions and research agenda, and an extensive bibliography. (Coffey-Florida) W79-07879

THE NATIONAL FLOOD INSURANCE PROGRAM REVISITED - AN UPDATED MODEL ORDINANCE FOR IMPLEMENTATION OF ITS LAND MANAGEMENT CRITERIA.

Florida Univ., Gainesville. F. E. Maloney, and D. C. Dambly. Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 483, Price codes: A03 in paper copy, A01 in microfiche. Florida Sea Grant College Program Technical Paper No. 3, December 1977, 46 p.

Descriptors: *Flood protection, *Flood plain insurance, *Flood plain zoning, *Flood plains, Planning, Land use, Land management, Insurance, Hazards, Regulation, Zoning.

In 1975, a model flood plain zoning ordinance was developed to assist communities in implementing the land management regulations adopted as part of the National Flood Insurance Program (NFIP). In 1976, the Federal Insurance Administration published the final land use regulations adopted under the NFIP. Significant differences between the pro-

posed and final regulations led to an updated model ordinance. Included is the entire updated model ordinance with commentary. The Model Flood Plain Management Ordinance contains the following: Section (1) Statutory authorization, findings of fact, purposes and objectives; Section (2) Definitions; Section (3) General provisions, and establishment of official zoning map; Section (4) Administration, creation of the flood plain administrator and flood plain construction authorization permits; Section (5) Establishment of zoning districts; Section (6) Floodway districts; Section (7) Flood fringe districts (FFD), the requirements within FFD, and areas of shallow flooding; Section (8) Coastal high hazard districts (CHH), requirements for development in CHH's, and guidance of future development; Section (9) Floodproofing; Section (10) Variances, requirements and procedures; Section (11) Nonconforming uses; Section (12) Subdivision regulation in flood hazard zone; Section (13) Penalties for violations; and regulation in flood hazard zone; Section (13) Penalties for violations; and Section (14) Severability. (Fortin-Florida) W79-07880

MUNICIPAL AND INDUSTRIAL WATER CONSERVATION - THE FEDERAL GOVERNMENT COULD DO MORE.

General Accounting Office, Washington, DC.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-279 487, Price codes: A05 in paper copy, A01 in microfiche. Report to the Congress, April 3, 1978, 39 p, 12 append.

Descriptors: *Water conservation, *Water supply, *Federal government, Water consumption, Water demand, Water pressure, Water shortage, Planning, Water use, Conservation.

An adequate water supply is essential to the nation's citizens and industries. If demand continues to increase, the nation will have to develop new supplies or use existing supplies more efficiently. Although the policy of Congress is that state and local governments are primarily responsible for water supply and regulation of water use, various federal programs offer numerous opportunities for encouraging and implementing water conservation programs. Federal agencies can: (1) provide funds for water resource planning; (2) construct dams and reservoirs to increase the supply; (3) construct and operate buildings and housing where water conservation can be undertaken; and (4) provide grants for construction of wastewater treatment facilities. Conservation is beneficial because it frees present supplies, precludes construction of supply and treatment facilities, and reduces future requirements for wastewater treatment facilities. An overview of opportunities for conserving municipal and industrial water supplies is provided which includes: (1) conservation techniques, including domestic water saving devices, metered usage, pricing structures, leakage control, water pressure control and educational campaigns, and (2) the potential for increased water conservation through existing federal programs. (Fortin-Florida) W79-07881

WATER RESOURCES PLANNING, MANAGEMENT, AND DEVELOPMENT: WHAT ARE THE NATION'S WATER SUPPLY PROBLEMS AND ISSUES.

General Accounting Office, Washington, DC.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-270 171, Price codes: A04 in paper copy, A01 in microfiche. July 28, 1977, 46 p.

Descriptors: *Water resource development, *Water management, *Water supply development, Water supply, Water demand, Water consumption, Water utilization, Resource allocation, Planning.

While the United States has an abundant water supply, the geographical distribution and availability of its water resources often do not match needs and demands. Existing and emerging water supply problems are identified. The focus is on the water and water-related programs and activities con-

cerned with water resources planning, management, and development projects designed to provide adequate water supplies to meet present and future demands. Water resources planning encompasses assessing quantity and quality of water supplies, forecasting demands, analyzing problems, and preparing proposals for resolving such problems. Water resources management covers water allocation among competing uses, technology development, and implementation of activities to reduce demand and conserve supplies. Water resource development projects are primarily concerned with project formulation, justification and construction. The current drought in the midwest and west with its devastating economic, environmental, and social impacts highlights the seriousness of the water problems facing our nation. Finding solutions to our water problems requires the establishment of clear priorities and timely and responsive implementing programs. (Fortin-Florida) W79-07882

A REVISION OF EXISTING REGULATIONS OF THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM.

Environmental Protection Agency, Washington, DC.

Federal Register, Vol. 43, No. 162, p 37078-37134, August 21, 1978.

Descriptors: *Discharge, *Federal jurisdiction, *Administration, *Water pollution control, Pollution abatement, Drainage engineering, Administrative agencies, Permits, State governments, Water pollution, Waste water.

Parts of the existing National Pollutant Discharge Elimination System (NPDES) regulations either are too terse to provide meaningful guidance, or leave significant permit-related issues unaddressed. Based upon several years of hearings by the federal Environmental Protection Agency the proposed regulations for part 124 provide more detailed procedures; parts 122 and 125 provide guidance on substantive questions formerly unaddressed in regulations. Accordingly four new parts of title 40 have been established, incorporating all of existing parts 122, 123, 124, 125 and 402, and portions of 36.900. There were three purposes behind these extensive revisions: (1) To clarify and improve existing program regulations and procedures in light of past experience; (2) To fill in significant gaps in coverage under existing regulations, particularly in response to court decisions and emerging emphasis on the control of toxic and hazardous pollutants; and (3) to make the necessary regulatory changes under the 1977 amendments to the Clean Water Act. (Fortin-Florida) W79-07883

FEDERAL WATER POLLUTION CONTROL ACT CONSTRUCTION GRANTS.

Environmental Protection Agency, Washington, DC.

Federal Register, Vol. 43, No. 80, p 17690-720, April 25, 1978.

Descriptors: *Federal water pollution control act, *Water pollution control, *Grants, *Administrative agencies, Regulation, Environmental control, Administration, Pollution abatement, Water pollution, Water policy, Contract administration.

These proposed changes to the regulations governing grants for construction of publicly-owned treatment works are intended to implement certain amendments to sections 201 (g), 201 (j), 202 (a), 203 (e) and 304 (d) of the Federal Water Pollution Control Act (FWPCA). The proposed regulations involve innovative and alternative technologies, recreational and open space uses and the provision of assistance by the federal Environmental Protection Agency (EPA) to grant recipients. Regulations that implement amendments to the FWPCA which affect waste water treatment works construction grant programs are administered by the EPA. These regulations deal primarily with the following subjects: (1) State priority; (2) grant eligibility categories; (3) Land eligibility; (4) user charges; (5) industrial cost recovery; (6) grants for

Group 6E—Water Law and Institutions

Solar energy is a hydrogen product. States that receive western states' energy becomes a real benefit is used for household requirements compared to The economic problems involved in isolated acquisition indicate that both are eventually available. The complicated theoretical While the cost is slightly higher, it might be justified to prevent damage to

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Since the mid-twentieth century, steps have been taken to conserve the Great Britain coast. Official and unofficial bodies have interacted to try to save the coast. Prior to 1965, the National Parks Committee and Nature Conservancy worked as independent bodies with coastal conservation and protection at the forefront of their activities. In 1965, the National Environment Research Council was created to encourage and support research in the earth sciences and ecology, disseminate advice and knowledge, establish and manage nature reserves, make grants and appoint committees. National and local trusts have also played an important role in saving parts of the coast. Many local coastal reserves are concerned with smaller areas. Many instances of coastal alteration can be cited, including planned residential development and the results of oil discovery. The country is now aware of dangers which could result from such changes. The essential point is that all interests must be discussed and assessed before any part of the coast is to be developed. (Ewing-Florida) W79-07899

RE-EMERGENCE OF A CONTROVERSY: ENFORCING ACREAGE LIMITATION,
C. H. Coleman.
Harvard Environmental Law Review, Vol. 2, p 329-41, 1978.

Descriptors: *Agriculture, *Land use, *Water users, *Irrigation, Judicial decisions, Administrative agencies, Farms, Cost-benefit theory, Environmental effects, Legislation.

In 1902, Congress passed the Reclamation Act. The purpose was to encourage the development of small family farms in the west. The Act required water users to reside on the irrigated land and limited to 160 acres the amount of land any one landowner could irrigate with federally-provided water. Some felt the Act was unenforceable, and hampered economically-efficient agricultural development. Others believed it the best means of preventing monopoly of land and water. An uneasy compromise resulted. Neither provision was repealed, but the pattern of enforcement included many special exemptions and modifications, listed here. Three court decisions and Department of Interior's proposed regulations indicate a trend toward a stricter enforcement policy. The implications of the recent decisions, including their potential impact on the environment, are explored. The stricter enforcement policy raises difficult questions, such as, how widespread the effects of the proposed rules will be, whether advances in farm technology have made 160-acre farms economically unfeasible, and whether the federal government should continue to subsidize project-water users. (Horwich-Florida) W79-07900

WATER LAW PROBLEMS OF SOLAR HYDROGEN PRODUCTION,
M. M. Eisenstadt.
Natural Resources Journal, Vol. 18, No. 3, p 521-44, July, 1978.

Descriptors: *Hydrogen, *Water utilization, *Energy, *Energy conversion, Federal water pollution control act, Prior appropriation, Brackish water, Acquirers, Surface water, Water law, Water supply, Water demand, Economics.

Solar energy is a prime candidate as a source for hydrogen production. The areas of the United States that receive the most sunlight are the southwestern states and Florida. If hydrogen economy becomes a reality and southwestern surface water is used for hydrogen production, the water requirements could dry up the southwestern rivers. The economic and technological aspects of the problems involved in using brackish water, from isolated aquifers, for hydrogen production indicate that both the water and technology are presently available. The legal problems are no more complicated than those dealing with surface water. While the cost of using brackish water would be slightly higher than that of fresh water, the cost might be justified, for brackish water would prevent damage to both the ecology and southwestern

citizens' lifestyle. Under its police power, the federal government could acquire as much surface water as needed to produce hydrogen. Commentators say the environmental damage must be balanced against the economic advantage of using surface water instead of brackish groundwater. (Fortin-Florida) W79-07901

ACREAGE AND RESIDENCY LIMITATIONS IN THE IMPERIAL VALLEY: A CASE STUDY IN NATIONAL RECLAMATION POLICY,
A. K. Kelley.
South Dakota Law Review, Vol. 23, No. 3, p 621-61, Summer, 1978.

Descriptors: *Reclamation, *Irrigation, *Judicial decisions, Irrigation programs, Legislation, Arid lands, Water delivery, Water distribution, Legal aspects, Water policy, Water resource development.

Since the turn of the century, irrigation in the arid areas of the western United States has become important. Much of the irrigation is made possible by federal reclamation projects. A controversial issue that arises regularly is who shall benefit from the water provided from these projects. Parties ranging from large corporate agricultural combines to the poorest of migrant farm workers have become aware of the opportunities presented by this 'liquid gold'. The areas receiving the greatest amount of commentary are the acreage limitation and the residency requirement, which limit water delivery from federal reclamation projects. In the case of *United States v. Imperial Irrigation*, the Ninth Court of Appeals had to decide whether restrictions should be placed upon water delivery in the prosperous Imperial Valley. Unfortunately, the court used an inflexible standing test to avoid analyzing the extremely significant residency requirement issue. The court's treatment of the acreage limitation question, demonstrated a proper recognition of the vital policies forming the foundation of the reclamation laws. (Fortin-Florida) W79-07902

RESERVED WATER RIGHTS, INDIAN RIGHTS AND THE NARROWING SCOPE OF FEDERAL JURISDICTION: THE COLORADO RIVER DECISION,
Wayne State Univ., Detroit, MI. Coll. of Law. R. H. Abrams.
Stanford Law Review, Vol. 30, No. 6, p 1111-48, July, 1978.

Descriptors: *Federal-state water rights conflicts, *Water rights, *Federal jurisdiction, Judicial decisions, Jurisdiction, Water law, Indian reservations, State jurisdiction, Federal government, Arid lands.

In 1976, the United States Supreme Court decided *Colorado River Water Conservation District v. United States*. The court held that principles of judicial administration relating to the 'contemporaneous exercise of concurrent jurisdictions' require that federal courts abjure congressionally granted, previously-attached jurisdiction of federal claims to reserved water rights. By establishing state courts as the primary forum for adjudicating all water rights within state boundaries, this decision dramatically extends state courts' control over reserved rights claims. This includes claims by the federal government as trustee for American Indian lands withdrawn by treaty or other congressional action. Although the decision did not abolish concurrent jurisdiction, it virtually assured adjudication of all claims in state courts. State courts may discriminate against federal claims in favor of state and private uses. The arguments favoring a federal forum are especially strong for reserved rights claimed on behalf of American Indians. Either the Court should reexamine the *Colorado River* decision, or, Congress should clarify the McCarron Amendment. Otherwise, the federal district courts must strike a new balance on a case-by-case basis, by declining to dismiss or remand Indian reserved rights claims. (Fortin-Florida) W79-07903

CAPPAERT V. UNITED STATES: A DEHYDRATION OF PRIVATE GROUNDWATER USE,
M. P. Bouret.
California Western Law Review, Vol. 14, No. 2, p 382-417, 1978.

Descriptors: *Federal-state water rights conflicts, *Groundwater, *Water rights, *Reservation doctrine, Federal government, State governments, Judicial decisions, Implied benefits, Arid lands, Underground, Prior appropriation.

During the last twenty years, the relationship between the western states and the federal government regarding water rights has steadily deteriorated. The problem was recently exacerbated by the *United States Supreme Court in Cappaert v. United States*. The Court held that when the federal government established Devils' Hole National Monument in Nevada, it implicitly reserved rights to unappropriated underground water which could not be lawfully encroached upon by adjacent landholders. The implied reservation doctrine was expanded for the first time to underground waters. When the federal government reserves land, it also reserves sufficient water to accomplish the purpose for which the land was taken. Landowners adjacent to the federal reservation have no idea how the governments' needs will affect their water supply until notified that their water use must be stopped or curtailed. This may be a taking of lands without prior notice and any compensation. The future demand for underground water supplies in the public and private sectors mandates a quantification of recordation of, and compensation for surface and underground water rights. (Fortin-Florida) W79-07904

ACID COAL MINE DRAINAGE: PAST POLLUTION AND CURRENT REGULATION,
West Virginia Univ., Morgantown. Coll. of Law. P. C. McGinley, and J. J. Sweet.
Duquesne Law Review, Vol. 17, No. 1, p 67-97, 1978-79.

Descriptors: *Acid mine water, *Mine acids, *Mine drainage, Mine waters, Mine wastes, Federal water pollution control act, Mining, Pollutants, Water pollution, Water pollution effects.

A cornerstone of the Carter Administration's energy program is the use of the country's extremely large bituminous coal reserves as a primary fuel source. The coal fuel cycle has an impact on air, water and land quality, and plant and animal life. Perhaps the most serious environmental problem with the mining of bituminous coal is the production of the ecologically damaging acid mine drainage (AMD) from deep and surface mines. An analysis of the early AMD cases suggest a judicial acceptance of the inevitability of such pollution. A practical and economically feasible method of treatment or abatement was not believed to exist. The court's failure to impose effective restraints on coal operators for AMD pollution, which occurs during and after mining, provided the coal industry substantial incentive to develop new abatement technologies. Only since the enactment of the Federal Water Pollution Control Act and vigorous enforcement of state environmental protection laws have great strides been made in developing and applying effective AMD abatement technology. (Fortin-Florida) W79-07905

RECENT CONGRESSIONAL ACTION ON OUTER CONTINENTAL SHELF OIL AND GAS DEVELOPMENT,
F. Craft, Jr.
Tulsa Law Journal, Vol. 13, No. 4, p 742-50, 1978.

Descriptors: *Continental shelf, *Legislation, *Oil, Coasts, Oil wells, Legal aspects, Administrative agencies, State governments, Federal jurisdiction, Federal state water rights conflict.

The energy crisis has increased the demand for oil and gas production from the ocean floor adjoining the United States coast. These demands conflict with the need to avoid ocean pollution and pre-

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serve the coastal environment. The issue is further aggravated by jurisdictional assertions between the federal and state governments and among member nations which will meet at the 1978 United Nations Conference on the Law of the Sea. The relevant issues in the Outer Continental Shelf bill are: (1) whether to lease before or after all environmental questions are answered; (2) whether to accelerate or halt leasing until the need has been thoroughly demonstrated; (3) how much influence state and local governments should have in development; (4) what revisions of the bidding system are necessary; and (5) what types of antitrust reviews should be available. Unfortunately, Congress to date has ignored the need to increase domestic production. Congress is still preoccupied with enacting environmental legislation which grew out of the causes of the early 1970's. (Fortin-Florida) W79-07906

ASSESSMENT OF CIVIL MONETARY PENALTIES FOR WATER POLLUTION: A PROPOSAL FOR SHIFTING THE BURDEN OF PROOF REGARDING DAMAGES,
D. P. Taylor.
Hastings Law Journal, Vol. 30, No. 3, p 651-82, January, 1979.

Descriptors: *Water pollution, *Damages, *Penalties, *Economics, Water quality, Legislation, Judicial decisions, Administrative agencies, Effluents, Cost allocation, Compensation.

The issue of assessing and imposing the appropriate amount of civil and monetary penalties for violation of water quality statutes is not unique to California; it arises in many other states and at the federal level because such penalties have become a key enforcement remedy in environmental legislation. Depending on the particular statutory scheme, such penalties may be assessed and imposed by administrative agencies or by the courts. The efficiency of the penalties is determined largely by the method of assessment and imposition used. Uncertainty often arises in judicial assessment proceedings because it is unclear what need be proved and by whom under the penalty statute. Effective water pollution enforcement will be frustrated if the state is required to bear the burdens of proof concerning damages. The proposal is that a showing of statutory violation would raise a rebuttable presumption of a maximum \$10,000 per day penalty. This amount is considered appropriate to deter future violation and compensate for unquantifiable harm. The polluter then must prove a lower amount was warranted. (Fortin-Florida) W79-07907

PROTECTING MASSACHUSETTS WETLANDS,
Suffolk Univ., Boston, MA.
A. D. Dawson.
Suffolk University Law Review, Vol. 12, No. 4, p 755-95, 1978.

Descriptors: *Regulation, *Wetlands, *Floodplains, *Massachusetts, Land fills, Coastal marshes, Zoning, Permits, Floods, Flood control, Flood protection, Water supply, Natural resources, Marshes, Compensation, Excavation, Shores, Navigable waters, Tidal waters, Constitutional law.

Massachusetts has enacted a variety of laws designed to protect wetlands and floodplains. State and local regulatory activity has produced much litigation. Massachusetts' case law may foreshadow decisions elsewhere as environmental laws collide with the expanding interests of private landowners. Massachusetts cases and references to the decisions from other states that have most influenced Massachusetts courts in providing wetland protection are concentrated upon. There are four parts: (1) an overview of Massachusetts statutes; (2) a discussion of judicial decisions concerning wetlands, including a detailed analysis of the most recent case, *MacGibbon v. Board of Appeals of Duxbury* (MacGibbon III). *MacGibbon III* may signal a reversal of the liberal trend regarding the taking issue in environmental cases; (3) a comparison of *MacGibbon III* with other states' decisions; and (4)

a summary of lessons derived from Massachusetts cases and statutes, which may be useful to lawyers, legislators and administrators who seek to protect wetlands through governmental regulation. (Coffey-Florida) W79-07908

CURRENT GROUNDWATER LAW IN ARIZONA,
M. N. Goodman.
Arizona State Law Journal, Vol. 1978, No. 2-3, p 205-24, 1978.

Descriptors: *Arizona, *Groundwater, *Legislation, *Regulation, Legal aspects, Water law, Water policy, Water supply, Federal government, State governments.

The state of groundwater law in Arizona has never been certain. Historical developments are unraveled to determine whether they are useful in interpreting the 1977 Groundwater Act (Act) in developing a sound water policy for the future. Three aspects of the Act apt to provoke more litigation are examined. These provisions relate to: (1) groundwater transfers; (2) rights, liabilities and remedies under the Act; and (3) a moratorium on the establishment of additional critical groundwater areas. The Groundwater Management Study Commission created by the Act and the constitutional problem it raises are viewed. The implied reservation problem resulting from the federal litigation is discussed. The Arizona legislature has acted occasionally to relieve the pressures created by the water scarcity, but it appears to act more out of desperation than determination to resolve a serious problem. The Act is no exception. It is a stop-gap measure which seems to raise more problems than it solves. (Ewing-Florida) W79-07909

FEDERAL ENFORCEMENT PROCEEDINGS UNDER THE 1977 CLEAN WATER ACT,
S. L. Hartman.
Temple Law Quarterly, Vol. 51, No. 4, p 884-911, 1978.

Descriptors: *Federal government, *Legislation, *Regulation, *Water pollution control, Federal water pollution control act, Water quality control, Waste treatment, Legal aspects, Water law, Standards, Water pollution.

The 1977 Clean Water Act (CWA) amended the Federal Water Pollution Control Act (the Act). The amendments' enactment signified a growing Congressional awareness that cleaning up this nation's waters will be a more complex task than initially anticipated. The failure of the Act to provide for flexibility in enforcing 1977 deadlines would have created a near impossible task for the federal Environmental Protection Agency and the courts. While addressing itself to the problem of such inflexibility, the CWA has serious deficiencies. Congress has given relief to sewage treatment works unable to achieve compliance due to inadequate or nonexistent federal funding, but the relief was only helpful to relieve past funding deficiencies. The relief does not extend to future difficulties. Although state and federal roles in the National Pollutant Discharge Elimination System program have been clarified, the CWA provides no guidance if permits or guidelines are issued in an untimely manner. To the extent that these problems remain in the Act, Congress has failed to ease the burden on the administrative and judicial processes. (Ewing-Florida) W79-07910

THE LOSS OF PUBLIC TIDELANDS TO PRIVATE PARTIES THROUGH UNCONSTITUTIONAL LAND TRADES,
L. Martyn, and H. Bohner.
San Francisco University Law Review, Vol. 13, No. 1, p 39-61, 1978.

Descriptors: *California, *Coasts, *Land resources, *Public rights, Public lands, Legal aspects, Legislation, Constitutional law, Control, Judicial decisions, Conservation.

In 1850, California became the owner of all the land in the state subject to the ebb flow and flow of the tide. These public tidelands are being filled and lost to private development despite provisions of the California Constitution which prohibit private ownership and monopoly of the tidelands. If the provisions of the California Constitution were enforced, loss of the tidelands to private development could be substantially reduced or halted. The loss of the tidelands is due, at least in part, by the state's failure to properly map and inventory its tidelands and by unconstitutional exchanges of tideland between state and private developers. Measures could be taken to alleviate further inroads into public trust lands: (1) Public Resources Code section 6307, authorizing exchange of state-owned lands for private lands of equal value, should be declared unconstitutional; (2) courts should stringently review any legislative determination freeing tidelands from the public trust; and (3) revenue from oil and minerals derived from patented tidelands should belong to the state tidelands trust fund. (Ewing-Florida) W79-07911

PUEBLO INDIAN WATER RIGHTS: WHO WILL GET THE WATER,
A. P. Maynez.
Natural Resources Journal, Vol. 18, No. 3, p 639-58, 1978.

Descriptors: *New Mexico, *Pueblo water rights, *Reservation doctrine, Water law, Judicial decisions, Legal aspects, Appropriation, Federal-state water rights conflicts, Federal government, Water control.

The basic issue before the court in *New Mexico v. Aamodt* was whether Pueblo water uses were controlled by state water law based on the doctrine of prior appropriation. The court held that pueblo water rights were not subject to state law. Court decisions have placed the pueblos firmly under the protection of the federal government. The court suggested that the pueblo water rights may be reserved rights. The landmark case defining reserved rights is *Winters v. United States*. The *Winters Doctrine* states that a land reservation established by treaty carries with it an implicit reservation of water, the amount being determined by the purpose of the reservation. The doctrine has not been confined to lands reserved by treaty. The court's suggestion, that the Pueblos may have reserved rights, may become the formulation of a new test. Under this test, the existence of such a right depends not upon whether there is a federal land reservation but upon whether there is federal control through guardianship over the land. This new test is a logical extension and refinement of the *Winters Doctrine*. (Ewing-Florida) W79-07912

GROUNDWATER - A FILTER FOR A MUDDY ISSUE. (LANDOWNERS' RIGHTS TO GROUNDWATER AS GOVERNED BY THE NEBRASKA PREFERENTIAL USE STATUTE),
A. R. Bosch.
Creighton Law Review, Vol. 12, No. 1, p 431-45, Fall, 1978.

Descriptors: *Nebraska, *Groundwater resources, *Water allocation(Policy), Water policy, Water supply, Water resources, State governments, Judicial decisions, Legal aspects, Groundwater.

In the recent case of *Prather v. Eisenmann*, the Nebraska Supreme Court clarified Nebraska law on groundwater use. There are four basic legal theories governing groundwater use: (1) the English/absolute ownership rule; (2) the American/reasonable use rule; (3) the California/correlative rights doctrine; and (4) the prior appropriation rule. The English rule states that the landowner has an absolute right to take the water beneath his land for any use, regardless of the effect on an adjoining landowner. The American rule limits a landowner's use to beneficial purposes having a reasonable relationship to his overlying land, regardless of the effect on the water supply to adjoining landowners. The correlative rights doctrine gives each landowner an equal and correlative

right to make the prior app the first pers water. Altho ment of grou solely on the which provid water for don W79-07913

PROPOSED THE ACRA TION LAW,
N. Jones.
Natural Reso 40, October, 1978.

Descriptors: tion, *Irrigati cal decision, tion, Land us

In a recent N tion on land district recei applied to C The current a in the 1926 C been enforce of Reclamation purpose of the a maximum nu ute the benef operated far Lands excee receive water contract for are then pul proved price tighten the c vide for imp restrict leas prices are su meet seriou tural operati terns may be ods. (Ewing- W79-07914

ACID MIN WATER AC Maryland D Water Resou S. S. Gofma In: The Freti and Env Symposium, land, Flynn, 112-113. Int River Basin, 78-2.

Descriptors: al Water P 1972, *Pollu trol, Mine v tion, Water ment financ

Active and tion in the developed b Pollution Co 92-500). In Energy and sponsible fo and water c charged to Section 208 ment and in identify min ing abandon and to pres trol them. T for mine w under Secti mentation f from abund have been

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right to make beneficial use of the groundwater. The prior appropriation doctrine grants priority to the first person who adopts a beneficial use of the water. Although Frather discussed the development of groundwater law, the decision was based solely on the Nebraska Preferential Use Statute which provides that preference in the use of underground water shall be given to those using the water for domestic purposes. (Ewing-Florida) W79-07913

PROPOSED RULES FOR ADMINISTERING THE ACREAGE LIMITATION OF RECLAMATION LAW,

N. Jones.
Natural Resources Journal, Vol. 18, No. 4, p 933-40, October, 1978.

Descriptors: *Reclamation, *Regulation, *Legislation, *Irrigation water, Federal government, Judicial decision, Legal aspects, Irrigated land, Irrigation, Land use, Administration.

In a recent Ninth Circuit Court opinion, the limitation on land an individual may own in an irrigation district receiving federal reclamation water was applied to California's Imperial Irrigation District. The current acreage limit of 160 acres was adopted in the 1926 Omnibus Adjustment Act, but has not been enforced. Pursuant to court order, the Bureau of Reclamation has proposed rules for enforcement of the acreage limitation. The rules provide for the purpose of the limitation: (1) to restore for a maximum number of farmers; (2) to widely distribute the benefits; (3) to promote family-sized owner-operated farms; and (4) to preclude speculation. Lands exceeding the acreage limitation may only receive water if the owner executes a recordable contract for sale of that land. Availability notices are then published and the land sold at an approved price. The proposed rules would also: (1) tighten the criteria for eligible purchasers; (2) provide for impartial selection of purchasers; and (3) restrict leasing of the excess lands. Sale and resale prices are subject to approval. Enforcement will meet serious opposition and may disrupt agricultural operations. Such a change in land-use patterns may be unfeasible for present farming methods. (Ewing-Florida) W79-07914

ACID MINE DRAINAGE AND THE CLEAN WATER ACT,

Maryland Dept. of Natural Resources, Annapolis. Water Resources Administration. S. S. Golfman.

In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978. p 112-113. Interstate Commission on the Potomac River Basin, Rockville, Md. Technical Publication 78-2.

Descriptors: *Mine drainage, *Legislation, *Federal Water Pollution Control Act Amendments of 1972, *Pollution abatement, *Water pollution control, Mine wastes, Acid mine water, Water pollution, Water pollution sources, Financing, Government finance, Government support, Maryland.

Active and abandoned mines are given consideration in the water quality management plans to be developed by each State under the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500). In Maryland the Bureau of Mines of the Energy and Coastal Zone Administration is responsible for controlling abandoned mine drainage, and water quality associated with active mines is charged to the Water Resources Administration Section 208 of P. L. 92-500 requires the development and implementation of a management plan to identify mine-related sources of pollution, including abandoned surface and underground runoff, and to prescribe methods and procedures to control them. The Federal government provides funds for mine water pollution control demonstrations under Section 107 of P. L. 92-500, but no implementation funds are provided to correct pollution from abandoned mines. The demonstration funds have been used by Maryland and other States to

aid in developing abatement techniques. Maryland acknowledged that the responsibility for abandoned mine pollution is statewide by enacting the Abandoned Mine Drainage Control Act, which authorized the prevention, control, and abatement of pollution from abandoned mines, and provided \$5 million to implement the provisions. Other legislation provides for a surcharge of 15 cents/ton of coal mined to be leveled, and a fee of \$40/acre of affected land surface to provide a continuous flow of funds for abatement projects. The State will match each \$40 put into the fund. (Davison-IPA) W79-07978

CONGRESSIONAL PERSPECTIVES ON CLEAN WATER,

Committee on Environment and Public Works (U. S. Senate), Washington, DC. P. T. Cummings.

In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978. p 179-181. Interstate Commission on the Potomac River Basin, Rockville Md. Technical Publication 78-2.

Descriptors: *Water pollution control, *Pollution abatement, *Legal aspects, *Legislation, *Water Pollution Control Act Amendments of 1972, Water quality control, Water quality standards, Water pollution sources, Committee on Environment and Public Works, Potomac River basin.

The legislative intent behind the 1972 Federal Water Pollution Control Act Amendments (P. L. 92-500) is examined. The full implications of the Act and its philosophy are contained in its first sentence: 'The object of this Act is to restore and maintain the chemical, physical and biological integrity of the Nation's Waters.' That congress has declared water pollution illegal is implicit in the no discharge goal of Section 101. To implement the basic decision that the Nation's waters are not to be used for waste disposal, Congress established regulatory and enforcement strategy and a system of subsidies to localities to aid in achieving the goals of the Act. The three basic principles in the act are: (1) to protect and restore the integrity of the natural systems in the Nation's waters, (2) man's activities are presumed to interfere with the Act's objective, and (3) the burden lies on the person who wishes to put something in the water to show that he will not interfere with the means to attain the Act's goals. The intent is to try to make man's activities compatible with the Act rather than restoring Pre-Columbian America. Issues before the Committee on Environment and Public Works for 1977 and 1978 include a review of the act, the mechanisms available for controlling nonpoint sources of pollution, funding of controls for storm-water run-off, the bioaccumulation and persistence of toxic pollutants, and acid mine drainage. (Davison-IPA) W79-07991

PROTECTING AQUATIC LIFE: WHAT CAN THE LAYMAN DO,

E. Wesely.

In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. D. and Mason, W. T., Eds., 1978. p 182-184. Interstate Commission on the Potomac River Basin, Rockville, Md. Technical Publication 78-2.

Descriptors: *Aquatic life, *Preservation, *Protection, *Attitudes, *Social function, Psychological aspects, Social values, Decision making, Social impact, Environmental effect, Social participation, Ecology, Pollution abatement, Water pollution control, Water quality standards.

A board member of the C and O Canal Association expresses his ideas and philosophy concerning the layman's role in protecting aquatic life. Examples are presented of lay participation in preventing the enactment of legislation which would result in environmentally harmful consequences, and grass roots action to seek environmental preservation

through legislation. It is thought that a skeptical attitude toward professional studies will aid the layman in maintaining his objectivity with regard to studies which appear to distort his own observations. In testimony before the Maryland Public Service Commission a representative of an institution which had monitored the aquatic environment of the Potomac River at the site of an electric powerplant for several years stated that the plant's discharge water was never sampled. Laymen sampled the plant's discharge plume in preparing evidence for the same hearing. Laymen also produced evidence that the electric power company had been discharging waste fly ash into the C and O Canal for several years. These and other examples of laymen monitoring institutional activity indicate that the role of the layman in protecting the environment is that of the 'watch dog'. (Davison-IPA) W79-07992

LEGAL AND SCIENTIFIC PERSPECTIVES,

Environmental Defense Fund, East Setauket, NY. Eastern Water Resources and Land Use Program. J. T. B. Trip, and R. H. Harris.

In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. D. and Mason, W. T., Eds., 1978. p 185-189, 4 tab, 14 ref. Interstate Commission on the Potomac River Basin, Rockville, Md. Technical Publication 78-2.

Descriptors: *Federal Water Pollution Control Act Amendments, *Planning, *Water pollution control, *Pollution abatement, *Water quality, *Water quality standards, Water pollution, Management, Legal aspects, Water resources, Protection.

The Potomac estuary is extremely polluted from nutritional inflows from the upper basin, combined sewer discharges in the metropolitan area, and direct discharges from sewage plants. At present no comprehensive plan exists for protecting biological resources, yet waste water treatment plants are being designed and constructed and decisions are being made about the location of discharges to the Potomac basin. Control of toxic pollutants into the Potomac River is essential to protect the biological resources, but little effort has been made to identify and control them, and EPA has not given much guidance in dealing with them. Due to lack of an effective plan to achieve the water quality as set forth in the 1972 Federal Water Pollution Control Act Amendments (FWPCA), EPA denied application for a construction grant for the Dickerson treatment plant in Montgomery County, Maryland. This is expected to accelerate consideration of land treatment and other alternatives which will meet the standards. It is concluded that the Potomac's ability to support its intended use will not be restored with current waste water management plan development, but that proper waste water management planning as required by the FWPCA can provide the correct basis for solving the problems. (Davison-IPA) W79-07993

6F. Nonstructural Alternatives

PROMISING STRATEGIES FOR RESERVING INSTREAM FLOWS,

Dewsnup (Richard L.)/Dallin W. Jensen, Salt Lake City, UT.

For primary bibliographic entry see Field 6A. W79-07878

THE NATIONAL FLOOD INSURANCE PROGRAM REVISITED - AN UPDATED MODEL ORDINANCE FOR IMPLEMENTATION OF ITS LAND MANAGEMENT CRITERIA,

Florida Univ., Gainesville.
For primary bibliographic entry see Field 6E. W79-07880

CONSERVATION DISTRICTS AND 208 WATER QUALITY MANAGEMENT-NON-POINT SOURCE IDENTIFICATION AND AS-

Field 6—WATER RESOURCES PLANNING

Group 6F—Nonstructural Alternatives

ASSESSMENT, SELECTION OF BEST MANAGEMENT PRACTICES, MANAGEMENT AGENCIES, REGULATORY PROGRAMS,
National Association of Conservation Districts,
Washington, DC.
For primary bibliographic entry see Field 4A.
W79-07886

WETLANDS RELATED LEGISLATION IN THE UNITED STATES,
Miami Univ., Coral Gables, FL. School of Law.
For primary bibliographic entry see Field 6E.
W79-07888

NATIONAL WATER QUALITY GOALS CANNOT BE ATTAINED WITHOUT MORE ATTENTION TO POLLUTION FROM DIFFUSED OR 'NONPOINT' SOURCES,
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 2E.
W79-07889

ASSESSMENT OF CIVIL MONETARY PENALTIES FOR WATER POLLUTION: A PROPOSAL FOR SHIFTING THE BURDEN OF PROOF REGARDING DAMAGES,
For primary bibliographic entry see Field 6E.
W79-07907

PROTECTING MASSACHUSETTS WETLANDS,
Suffolk Univ., Boston, MA.
For primary bibliographic entry see Field 6E.
W79-07908

6G. Ecologic Impact Of Water Development

OPPORTUNITIES FOR MAINTENANCE REHABILITATION OF RIPARIAN HABITATS: EASTERN UNITED STATES,
Virginia Polytechnic Inst. and State Univ., Blacksburg, Dept. of Biology.
For primary bibliographic entry see Field 5C.
W79-07518

THE COASTLINE,
For primary bibliographic entry see Field 2L.
W79-07717

LAGOONS,
Ferrara Univ. (Italy). Inst. of Zoology and General Biology.
For primary bibliographic entry see Field 2L.
W79-07719

SALT-MARSHES,
Delta Inst. of Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2L.
W79-07721

ESTUARIES,
University Coll. of Swansea (Wales). Dept. of Botany.
For primary bibliographic entry see Field 2L.
W79-07722

VOLUME III. THE WETLANDS/EDGES PROGRAM. RESEARCH ON THE CHESAPEAKE BAY TO PROVIDE A KNOWLEDGE BASE FOR PHYSICAL ALTERATIONS OF THE EDGES OF THE CHESAPEAKE BAY,
Chesapeake Research Consortium, Inc., Baltimore, MD.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-279 117.
Price codes: A03 in paper copy, A01 in microfiche.
Interim Progress Report, February 15, 1974. 32 p.
7 append. NSF/RANN 38973.

Descriptors: *Water resources development, *Shore protection, *Chesapeake Bay, *Permits,

*Assessment, Water resources, Water pollution, Wetlands, Shores, Coasts, Environmental effects, Topography, Geomorphology, Analysis, Evaluation, Regulation, Land use, Sedimentation, Erosion.

The design and composition of the program, technical accomplishments, and delivered products concerned with development of criteria for the incremental alteration in the edges of the Chesapeake Bay are presented. Progress of the shoreline situation is also reported. The approach involves: (1) a comprehensive analysis of permit applications for physical alteration of the edges of Chesapeake Bay (approximately 2,000) received by the Corps of Engineers during 1973, (2) detailed case studies of a representative set of permit applications, and (3) specific research projects designed to provide information identified as urgently needed by regulatory agencies for permit proposal decisions. Shoreline studies attempt to obtain a useful characterization and analysis of Chesapeake Bay shorelands with respect to morphological type, land use, and erosion and sedimentation characteristics. Currently, work is focused on the assessment of lower bay shorelands on a county-by-county basis. (Bollinger-Mass)
W79-07724

THE NATURAL RESOURCES OF THE NIPOMO DUNES AND WETLANDS. REPORT NUMBER 15 ON CALIFORNIA COASTAL WETLANDS,
California State Dept. of Fish and Game, Sacramento.
For primary bibliographic entry see Field 2L.
W79-07730

THE NATURAL RESOURCES OF AGUA HEDIONDA LAGOON. REPORT NUMBER 16 ON CALIFORNIA COASTAL WETLANDS,
San Diego Univ., CA. Environmental Studies Center.
For primary bibliographic entry see Field 2H.
W79-07731

THE NATURAL RESOURCES OF MUGU LAGOON. REPORT NUMBER 17 ON CALIFORNIA COASTAL WETLANDS,
California Univ., Santa Barbara. Marine Science Inst.
For primary bibliographic entry see Field 2L.
W79-07732

THE NATURAL RESOURCES OF ANAHEIM BAY--HUNTINGTON HARBOUR. REPORT NUMBER 18 ON CALIFORNIA COASTAL WETLANDS,
California State Dept. of Fish and Game, Sacramento.
For primary bibliographic entry see Field 2L.
W79-07733

DEVELOPER'S HANDBOOK,
Connecticut Dept. of Environmental Protection, Hartford. Coastal Area Management Program.
For primary bibliographic entry see Field 6B.
W79-07735

BIOLOGICAL PRODUCTION AND NUTRIENT STUDIES OF LAKE CHAMPLAIN,
Vermont Univ., Burlington. Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W79-07741

EFFECTS OF SPRING WATER LEVELS ON THE REPRODUCTION OF UPPER RICHELIEU AND MISSISQUOI BAY: NORTHERN PIKE (ESOX LUCIUS L.),
Quebec Univ., Montreal (Canada). Dept. of Biology.
For primary bibliographic entry see Field 2L.
W79-07742

LAKE CHAMPLAIN FISHERIES INVESTIGATION: UNITED STATES WATERS,

New York State Dept. of Environmental Conservation, Albany.
For primary bibliographic entry see Field 2L.
W79-07743

ANALYSIS OF ECONOMIC EFFECTS OF WATER SURFACE ELEVATIONS ON U.S. SHORELINE OF LAKE CHAMPLAIN, NEW YORK AND VERMONT,
URS/Madigan-Praeger, Inc., New York.
For primary bibliographic entry see Field 6B.
W79-07744

FEDERAL RESERVED WATER RIGHTS SINCE PILLRC,
Wyoming Univ., Laramie.
For primary bibliographic entry see Field 6E.
W79-07875

PROMISING STRATEGIES FOR RESERVING INSTREAM FLOWS,
Dewsnup (Richard L.)/Dallin W. Jensen, Salt Lake City, UT.
For primary bibliographic entry see Field 6A.
W79-07878

THE NATIONAL FLOOD INSURANCE PROGRAM REVISITED - AN UPDATED MODEL ORDINANCE FOR IMPLEMENTATION OF ITS LAND MANAGEMENT CRITERIA,
Florida Univ., Gainesville.
For primary bibliographic entry see Field 6E.
W79-07880

CONSERVATION DISTRICTS AND 208 WATER QUALITY MANAGEMENT-NON-POINT SOURCE IDENTIFICATION AND ASSESSMENT, SELECTION OF BEST MANAGEMENT PRACTICES, MANAGEMENT AGENCIES, REGULATORY PROGRAMS,
National Association of Conservation Districts, Washington, DC.
For primary bibliographic entry see Field 4A.
W79-07886

WETLANDS RELATED LEGISLATION IN THE UNITED STATES,
Miami Univ., Coral Gables, FL. School of Law.
For primary bibliographic entry see Field 6E.
W79-07888

WATER WAY PRESERVATION: THE WILD AND SCENIC RIVERS ACT OF 1968,
For primary bibliographic entry see Field 6E.
W79-07895

HARBOR LINES AND THE PUBLIC TRUST DOCTRINE IN WASHINGTON NAVIGABLE WATERS,
Washington Univ., Seattle. School of Law.
For primary bibliographic entry see Field 4C.
W79-07897

SAVING THE COAST: THE BRITISH EXPERIENCE,
Saint Catherine's Coll., Cambridge (England).
For primary bibliographic entry see Field 6E.
W79-07899

RE-EMERGENCE OF A CONTROVERSY: ENFORCING ACREAGE LIMITATION,
For primary bibliographic entry see Field 6E.
W79-07900

WATER LAW PROBLEMS OF SOLAR HYDROGEN PRODUCTION,
For primary bibliographic entry see Field 6E.
W79-07901

BIOMASS MEASUREMENTS OF BENTHIC INVERTEBRATES,

Texas Univ. Marine Lab.
For primary bibliographic entry see Field 6E.
W79-07920

ENVIRONMENTAL IMPACT OF OUTER COASTAL AND CHEMICALS A-F,
Texas Univ. Marine Lab.
For primary bibliographic entry see Field 6E.
W79-07927

TOXIC MATERIALS IN THE ENVIRONMENT, Oregon State University. Research Institute. Available from Service, Springfield, MA. Price codes: A03 in paper copy, A01 in microfiche. Seminar Conference. SEMINAR WR-129, ref. C.

Descriptors: *Water pollution, *Water chemistry, Algae, Stream, Clean Air Act, Water quality.

A compilation examining socioeconomic environmental sources. Institute of Environmental Studies, University of California, Berkeley. ing, and facilities, and coordination of multidisciplinary land resource management. logical dilemmas, evaluation, and materials in the management of hazardous chemicals in the environment. control of hazardous waste.
W79-07962

**THE FISHERIES OF MARYLAND. MAC, Maryland Department of Water Resources. For primary bibliographic entry see Field 6E.
W79-07972**

7. RESOURCES

7B. Data

AN EMPIRICAL EVALUATION OF ORGANISMS IN THE NATIONAL POND J. Boreman, Christenson. Report No. 14, fig. 11.

Descriptors: *Aquatic animals, Fish populations, Growth, Shells.

A generalization empirically movement of the impact on fish at stages of the adjacent water or nursery habitat. matting the that fraction killed due to

RESOURCES DATA—Field 7

Data Acquisition—Group 7B

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
For primary bibliographic entry see Field 5C.
W79-07920

ENVIRONMENTAL STUDIES, SOUTH TEXAS OUTER CONTINENTAL SHELF, BIOLOGY AND CHEMISTRY. VOLUME III - APPENDICES A-F.

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
For primary bibliographic entry see Field 5C.
W79-07927

TOXIC MATERIALS IN THE AQUATIC ENVIRONMENT.

Oregon State Univ., Corvallis. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 837. Price codes: A08 in paper copy, A01 in microfiche. Seminar Conducted Spring Quarter 1978, Report SEMIN WR 024-78, July 1978. 165 p, 23 fig, 26 tab, 129 ref. OWRT A-999-ORE (23).

Descriptors: *Aquatic environment, *Toxicity, *Water pollution, *Bioassay, *Heavy metals, *Water chemistry, *Legal aspects, Water analysis, Algae, Streams, Pesticide residues, Biodegradation, Clean Air Act, Federal Water Pollution Control Act, Water quality, Water quality standards.

A compilation of eight papers from a weekly series examining some aspects of toxic pollution of the aquatic environment is provided. The Water Resources Institute on the campus of Oregon State University serves the state by fostering, encouraging, and facilitating water research; it administers and coordinates statewide and regional programs of multidisciplinary research in water and related land resources. The topics covered are: our toxicological dilemma, algal bioassay techniques for pollution evaluation, terrestrial laboratory microorganisms—their relationship to water resources, toxic materials in forest streams, toxicological considerations of heavy metals in the aquatic environment, chemicals in our water, petroleum in the marine environment, and Federal legislation for the control of hazardous/toxic substances. (Davison-IPA) W79-07962

THE FISHERY OF THE PIEDMONT POTOMAC.

Maryland Dept. of Natural Resources, Annapolis. Water Resources Administration.
For primary bibliographic entry see Field 5C.
W79-07972

7. RESOURCES DATA

7B. Data Acquisition

AN EMPIRICAL TRANSPORT MODEL FOR EVALUATING ENTRAINMENT OF AQUATIC ORGANISMS BY POWER PLANTS.

National Power Plant Team, Ann Arbor, MI. J. Boreman, C. P. Goodyear, and S. W. Christenson.
Report No. FWS/OBS-78/90, November 1978. 80 p, 14 fig, 11 tab, 12 ref, 3 append.

Descriptors: *Mathematical models, *Entrainment, *Aquatic animals, *Environmental effects, Mortality, Fish populations, Distribution patterns, Life cycles, Growth stages, Aquatic habitats, Movement, Shellfish, Water pollution effects.

A generalized mathematical model incorporating empirically derived organism distribution and movement characteristics is developed for assessing the impact of powerplant entrainment mortality on fish and shellfish populations. The early life stages of these aquatic organisms which inhabit the adjacent water body or use the area as a spawning or nursery habitat are of particular concern. Estimating the conditional entrainment mortality rate, that fraction of the population which would be killed due to entrainment in the absence of any

other source of mortality, is the first step in assessing the impact of entrainment mortality. The mathematical formulation is presented in which the mortality rates due to natural causes and entrainment are time-, space-, and age-specific. The input data needed involves: specifying geographic regions within the water body to define the movement and distribution of the organisms while they are vulnerable to entrainment; estimating physical factors; determining entrainment susceptibility for the life stages in each region as a function of calendar time; determining the length of time of organism vulnerability; and calculating life stages distribution among the regions of the water body as a function of calendar time. The model is applied to a hypothetical example. The limitations in the application of this model include the inability of current technology to separate the processes of mortality and movement of entrainable organisms, and the use of distribution data collected under specific conditions which may vary from year to year. (Davison-IPA) W79-07515

COMPARTMENTED SEDIMENT TRAP.

Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W79-07538

EVAPOTRANSPIRATION COMPUTED TO ESTIMATE LEACHING FRACTIONS.

Science and Education Administration, Grand Junction, CO.
For primary bibliographic entry see Field 2D.
W79-07546

THE APPLICATION OF AERIAL AND SATELLITE SNOW-MAPPING TECHNIQUES FOR MULTI-PURPOSE RESERVOIR SYSTEM OPERATIONS IN ARIZONA.

Salt River Project, Phoenix, AZ; and Geological Survey, Phoenix, AZ. Water Resources Div. E. Kirdar, H. H. Schumann, and W. L. Warskow. Available from U.S. Soil Conservation Service, Courthouse, Spokane, WA. In: Proceedings of 45th Annual Meeting, Western Snow Conference, Albuquerque, New Mexico, April 18-21, 1977, p 95-101. 4 fig, 7 ref.

Descriptors: *Snow cover, *Mapping, *Arizona, *Aerial photography, *Satellites(Artificial), River basins, Water storage, Reservoirs, Snowmelt, Remote sensing, Analytical techniques, *Salt River, *Verde River.

The Salt River Project encompasses about 250,000 acres in central Arizona and provides municipal, industrial and agricultural water for a large majority of the Salt River Valley's 1.2 million residents. About 76 percent (1966-1975 average) of the Project's total annual water demand of 1,277,000 acre feet comes from its multi-purpose reservoir system. The remaining 24 percent of its total demand is produced by 255 deepwell pumps. The reservoir system is comprised of six dams having a total water storage capacity of 2,072,000 acre feet. Four of the six dams are located on the Salt River and two on the Verde River. About 75 percent of the mean annual runoff (1913-74) from the Salt and Verde Rivers originates from winter cyclonic and frontal storms during the December-May runoff season. Much of the precipitation from these storms falls as snow. Snow deposited above 7,000 feet elevation normally remains until the spring snowmelt period of March, April and May. However, about 90 percent of the total 13,000 square miles watershed lies below 7,000 feet elevation. Snow that falls on this area is ephemeral in nature and subject to very rapid melt. Because of the large areal extent of this portion of the watershed and the instability of its snowpack, very high runoff volumes have been experienced in relatively short periods of time, creating major flooding. Three satellite systems are being used to provide timely information for evaluating Salt-Verde watershed conditions. These systems, the Landsat, ITOS and SMS/GOES satellites are being evaluated under the NASA funded Applications Systems Verification Test (ASVT) on Snowcover Map-

ping. A brief description of each satellite system is presented with a discussion of satellite image interpretation techniques. (Woodard-USGS) W79-07695

EXISTING STATE AND LOCAL WETLAND SURVEYS (1965-1975). VOLUME II: NARRATIVE.

Martel Labs., Inc., Baltimore, MD.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-278 427. Price codes: A20 in paper copy, A01 in microfiche. Prepared for Fish and Wildlife Service, Washington, D.C., Office of Biological Services, May 1976. 454 p, 119 ref, 4 append.

Descriptors: *Wetlands, *Surveys, *Legislation, Census, Data collections, Land use, Marsh management.

In preparation for a National Wetland Inventory, recent existing wetland surveys were identified. This report summarizes inventories performed in each State, and includes the reasons for the inventory, the methods used, the products prepared and key persons to contact for more information. A synopsis is provided of State Legislation that pertains to the management, protection, or identification of wetlands. (Steiner-Mass) W79-07726

AN ISOTOPIC STUDY OF GROUNDWATER SEEPAGE IN THE CENTRAL KENTUCKY KARST.

Scottish Research Reactor Centre, East Kilbride.
For primary bibliographic entry see Field 2F.
W79-07757

INNOVATIONS SIMPLIFY SHALLOW WELL MONITORING.

National Water Well Association, Worthington, OH.
R. Gronowski.
Water Well Journal, Vol. 33, No. 6, p 57, July, 1979.

Descriptors: *Groundwater, *Water quality, *Monitoring, *Shallow wells, Water sampling, Instrumentation, On-site data collections, Propane, Pumps, Plastic pipes.

Conventional methods of monitoring ground water quality are complex, time-consuming and expensive. An innovative device for ground water sampling, developed in Canada, allows variable depth monitoring through the installation of a single length of pipe. This multilevel device consist of a bundle of polypropylene tubes within a polyvinyl chloride (PVC) pipe which permits sampling at various levels. Before water samples can be taken, the tubes must be flushed by rapid pumping. Cost of materials for a 12 meter sampler with 20 sampling points is approximately \$60. Another sampling device recently developed by Johnson Div., UOP, can be used in wells with diameters as small as one inch. Pumping is accomplished through the use of a 14-ounce propane cylinder connected to dual-conductor plastic tubing. Propane injected down one side of the tubing forces water to rise up the other side to ground surface. The Johnson sampler is portable, easy to operate and inexpensive. These innovations will make ground water quality monitoring in shallow wells more economical and efficient. (Purdin-NWWA) W79-07761

INVESTIGATION OF THE ORION RESEARCH AMMONIA MONITOR.

Environmental Monitoring and Support Lab., Cincinnati, OH. Instrumentation Development Branch.

R. J. O'Herron.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-271 648. Price codes: A03 in paper copy, A01 in microfiche. Report EPA-600/4-77-028, 1977. 32 p, 12 fig, 9 tab, 14 ref.

Descriptors: *Instrumentation, *Analytical techniques, *Ammonia, *Performance, *Monitoring,

Field 7—RESOURCES DATA

Group 7B—Data Acquisition

Laboratory test, On-site investigations, Waste water treatment, Sewage treatment.

The Orion Research ammonia monitor was investigated for its intended applications using Orion specifications and environmental considerations as a guide. Laboratory tests under controlled environmental conditions indicated that the electronic stability (drift) was well within + or - 10% of reading over the temperature range 5 to 42°C. Sensor stability was tested by applying ammonia nitrogen in standard solutions of 10 mg/liter, 50 mg/liter, and 100 mg/liter as directed input to the monitor. Automatic standardization maintained readings within Orion's specified tolerance of + or - 10% of reading. On-stream measurements were made of a secondary sewage treatment plant effluent. These measurements were compared with those made with the standard method of distillation and titration. 65% of the comparisons were within 10% of reading. Steady-state comparisons made of field-collected samples with distillation-titration indicated that a 5% ammonia loss resulted from the straining and filtering of the sample input to the monitor. Eight of the nine samples compared were within 10% of the standard method. (Small-FRC)
W79-07776

NATIONAL WATER QUALITY GOALS CANNOT BE ATTAINED WITHOUT MORE ATTENTION TO POLLUTION FROM DIFFUSED OR 'NONPOINT' SOURCES.
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 2E.
W79-07889

PROBLEMS AFFECTING USEFULNESS OF THE NATIONAL WATER ASSESSMENT WATER RESOURCES COUNCIL.
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 4A.
W79-07893

7C. Evaluation, Processing and Publication

MAP OF ANTELOPE VALLEY-EAST KERN WATER AGENCY AREA, CALIFORNIA, SHOWING GROUND-WATER SUBUNITS AND AREAS, LOCATION OF WELLS, AND LINES OF EQUAL DEPTH TO WATER FOR SPRING, 1978.
Geological Survey, Menlo Park, CA. Water Resources Div.
G. G. Blankenbaker.
Geological Survey open-file map 78-937, 1978. 1 sheet.

Descriptors: *Maps, *Water wells, *Water levels, *Aquifers, California, *Antelope Valley-East Kern Water Agency area, *Groundwater subunits.

The U.S. Geological Survey has released to the open file a map showing ground-water subunits and areas, and depth to water for spring 1978, in the Antelope Valley-East Kern Water Agency area, California.
W79-07701

ROLE OF U.S. GEOLOGICAL SURVEY IN ILLINOIS.
Geological Survey, Champaign, IL. Water Resources Div.
L. A. Martens.
In: Illinois Water Resources in a Changing Environment; Proceedings of Fifth Illinois Water Resources Conference, Chicago, Illinois, June 10-11, 1977: American Water Resources Association, Illinois Section, p 48, 1977.

Descriptors: *Illinois, *Projects, *Data collections, *Available water, *Water quality, Surface waters, Streamflow, Hydrologic data, Groundwater, Management, Cost sharing, Cooperatives, *U.S. Geological Survey.

The U.S. Geological Survey (USGS), in Illinois, conducts hydrologic research, collects water re-

sources data, and provides technical assistance to Federal, State, and local agencies. Since the 1920's, the USGS water resources program has been aided materially by financial and technical cooperation with the State and local agencies, usually on a 50-50 basis, and by transfer of funds from other Federal Agencies operating in the water resources field. The USGS determines the source, quantity, quality, distribution, movement, and availability of both surface and ground water. These data are published and disseminated for the benefit of all data users, whether at the national, State, local, or individual level. (Woodard-USGS)
W79-07711

WATER RESOURCES OF THE WACCASASSA RIVER BASIN AND ADJACENT AREAS, FLORIDA.
Geological Survey, Tallahassee, FL. Water Resources Div.
G. F. Taylor, and L. J. Snell.
Geological Survey Water-Resources Investigations 77-101 (open-file report), 1978. 1 sheet, 7 fig, 3 tab, 6 ref.

Descriptors: *Maps, *River basins, *Available water, *Water quality, *Florida, Surface waters, Groundwater resources, Surface-groundwater relationships, Rainfall-runoff relationships, Topography, Streamflow, Water wells, Aquifers, Water utilization, Water resources development, Land use, *Waccasassa River basin.

This map report was prepared in cooperation with the Southwest Florida Water Management District which, with the Waccasassa River Basin Board, had jurisdiction over waters within the Waccasassa River basin, the coastal areas adjacent to the basin, and other adjacent areas outside the basin. New water management district boundaries, effective January 1977, place most of the Waccasassa River basin in the Suwannee River Water Management District. The purpose of the report is to provide water information for consideration in land-use and water development which is accelerating, especially in the northeastern part of the study area. It is based largely on existing data in the relatively undeveloped area. Of the total area included in the topographic drainage basin for the Waccasassa River about 72 percent is in Levy County, 18 percent in Alachua County, 9 percent in Gilchrist County, and 1 percent in Marion County. The elongated north-south drainage basin is approximately 50 mi in length, averages 13 mi in width, and lies between the Suwannee River, the St. Johns River, and the Withlacoochee River basins. (Woodard-USGS)
W79-07712

VARIATIONS IN SPECIFIC YIELD IN THE OUTCROP OF THE CARRIZO SAND IN SOUTH TEXAS AS ESTIMATED BY SEISMIC REFRACTION.
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 2F.
W79-07750

A COMPUTER PROGRAM FOR WELL LOGS.
R. B. McDannald.
Water Well Journal, Vol. 33, No. 6, p 34-35, July, 1979.

Descriptors: *Computer programs, *Drilling logs, *Well data, Data processing, Data storage and retrieval, Programming languages, Digital computers.

A computer program for the creation, sorting and searching a file of well logs is listed. It is written in BASIC and is specifically designed for the Commodore PET computer. Some minor de-bugging may be required to adapt the program for other brand home computers. Documentation of the program will be provided in a forthcoming article. (Purdin-NWVA)
W79-07758

JORDAN AQUIFER OF IOWA.
Geological Survey, Iowa City, IA.

For primary bibliographic entry see Field 2F.
W79-07769

WATBUG: A FORTRAN IV ALGORITHM FOR CALCULATING THE CLIMATIC WATER BUDGET.
Delaware Univ., Newark. Water Resources Center.
C. J. Willmott.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 763. Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center, Delaware University, Contribution No. 23, Report No. 1, and Publications in Climatology, Vol. XXX, No. 2, 1977. 58 p, 2 fig, 1 tab, 12 ref, 3 append. OWRT A-040-DEL(1).

Descriptors: *Computer programs, *Hydrologic budget, *Algorithms, Evapotranspiration, Water balance, Mathematics, Data storage and retrieval, Data transmission, Data collections, Soil moisture, Precipitation (Atmospheric), Air temperature, Moisture availability, Moisture deficit.

The computer program described is designed for use in a variety of problems, and requires a minimum amount of input information. Every effort was made to make the code transparent, so that it could be easily modified should additional or alternative computations be desired. Currently the program uses the Thornthwaite (1948) method for calculating potential evapotranspiration; the sub-routines where the estimates are made may be replaced by another method. The advantages of WATBUG over most previously published water budget programs include: (1) budgets can be computed on a monthly or daily basis; (2) records of monthly budgets up to 40 years and daily budgets up to one year can be repeated to 'balance the budget'; (3) all relationships are explicitly specified so that 'look-up' tables are not required; (4) the program is easily modified; and (5) multiple budgets may be done in a single run. The program requires that periods of time evaluated as a single budget be consecutive. A variety of multi-annual monthly and daily data sets were used to test all WATBUG's options. Hand computations made for comparison with the results of each test run were in agreement within a mm or two. These slight differences occur because intermediate values are rounded to whole numbers at each step in hand calculations and rounding errors may accumulate. In WATBUG, rounding to the nearest whole mm takes after the budget terms have been calculated just prior to their being written on paper. (Davison-IPA)
W79-07773

MAP SHOWING GENERAL AVAILABILITY OF GROUND WATER IN THE KAIPAROWITZ COAL-BASIN AREA, UTAH.
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 4B.
W79-07938

WATER RESOURCES OF THE KODIAK-SHELIKOF SUBREGION, SOUTH-CENTRAL ALASKA.
Geological Survey, Anchorage, AK. Water Resources Div.
S. H. Jones, R. J. Madison, and C. Zenone.
Available from Branch of Distribution, USGS 1200 S. Eads St. Arlington VA 22202 price \$3.50. Geological Survey Hydrologic Investigations Atlas HA-612, 1978. 2 sheets, 22 ref.

Descriptors: *Maps, *Water resources, *Surface waters, *Groundwater, *Water quality, Hydrogeology, Aquifer characteristics, Water wells, Water levels, Hydrologic data, Precipitation (Atmospheric), Runoff, Streamflow, Specific conductivity, Water temperature, Alaska, *Kodiak-Shelikof subregion.

Hydrologic data for the Kodiak-Shelikof subregion of south-central Alaska are summarized to provide a basis for planning water resources development, identifying water problems and evaluating existing

Hydraulics—Group 8B

water quality and availability. Average annual precipitation, measured at a few coastal locations in this maritime climatic zone, ranges from 23 to 127 inches. Mean annual runoff for the Kodiak Island group ranges from 4 to 8 cfs/sq mi. A maximum instantaneous runoff of 457 cfs/sq mi has been determined from a small basin on Kodiak Island. Lowest measured stream discharges range from no flow to 0.91 cfs/sq mi. Surface water is the primary source of water supplies for the city of Kodiak and other communities. The geology of the subregion is characterized by metamorphosed sedimentary and volcanic rocks with only a thin mantle of unconsolidated material. A few small, alluvium-filled coastal valleys offer the most favorable conditions for ground-water development, but moderate yields (50-100 gal/min) have been obtained from wells in fractured bedrock. Water in streams and lakes generally has a dissolved-solids concentration less than 60 mg/L, and the water varies from a calcium-bicarbonate type to a sodium-chloride type. The chemical composition of ground waters has a dilute calcium-bicarbonate type in unconsolidated materials and a sodium-bicarbonate type in bedrock. The dissolved solids in the ground-water ranges from 170 to 250 mg/L. (Woodard-USGS) W79-07939

THE CITRONELLE AQUIFERS IN MISSISSIPPI.
Geological Survey, Jackson, MS. Water Resources Div.
E. H. Boswell.
Geological Survey Water-Resources Investigations 78-131 (open-file report), 1979. 1 sheet, 4 fig, 1 tab, 19 ref.

Descriptors: *Groundwater resources, *Mississippi, *Aquifer characteristics, *Water quality, *Water levels, Maps, Water wells, Water yield, Hydrogeology, Water analysis, Chemical analysis, Water utilization, *Citronelle Formation, Miocene aquifers, Pliocene aquifers.

The Citronelle aquifers consist of sand and gravel of Pliocene age that forms a discontinuous outcrop area of about 6,000 square miles in southern Mississippi. The beds dip to the south at an average rate of about 6 feet per mile. The unconfined aquifers are used mostly for domestic and farm use but also supply water to several municipalities and industries. The average saturated thickness of the aquifers is about 45 feet. This physically limits drawdown space and, although specific capacities are high, yields generally do not exceed a few hundred gallons per minute. Water levels have not declined significantly because withdrawals are small. Water quality is generally good although in some places there are objectionally high concentrations iron and in some the water is acidic. (Woodard-USGS) W79-07940

WATER FOR MUNICIPAL AND INDUSTRIAL DEVELOPMENT IN HINDS, MADISON, AND RANKIN COUNTIES, MISSISSIPPI.
Geological Survey, Jackson, MS. Water Resources Div.
C. A. Spiers, and G. J. Dalsin.
Mississippi Research and Development Center, 1979. 78 p, 31 fig, 10 tab, 43 ref.

Descriptors: *Mississippi, *Water resources, *Surface waters, *Groundwater resources, *Water quality, Water utilization, Hydrologic data, Water supply, Streamflow, Gaging stations, Low flow, Flood frequency, Aquifer characteristics, Water wells, Water yield, Water levels, Chemical analysis, Maps, Industrial water, Municipal water, *Hinds County(Miss), *Madison County(Miss), *Rankin County(Miss).

Hinds, Madison, and Rankin Counties occupy an area of 2,428 square miles in southwest-central Mississippi. Water use for the area during 1976 was 51 million gallons per day of which 25 million gallons per day were obtained from ground-water sources. However, the largest water user in the area, the city of Jackson, obtains most of its water from the Pearl River. Surface-water resources include the Pearl and Big Black Rivers and the Ross

Barnett Reservoir. The average runoff contributed by the area to the various rivers is 1,990 million gallons per day. The chemical and physical quality of water in streams of the area is generally suitable for most uses. The principal aquifers are the Meridian-upper Wilcox aquifer, Sparta Sand, the Cockfield Formation, the Forest Hill Sand, and the Catahoula Sandstone. From Jackson southward the base of freshwater generally occurs at the base of the Sparta Sand. The report concludes a series of 16 multicounty water-resources investigations in Mississippi. (Woodard-USGS) W79-07944

HYDROLOGY OF THE BEAVER VALLEY AREA, BEAVER COUNTY, UTAH, WITH EMPHASIS ON GROUND WATER.
Geological Survey, Salt Lake City, UT. Water Resources Div.
R. W. Mower.
Utah Department of Natural Resources Technical Publication 63, 1978. 90 p, 18 fig, 3 plates, 17 tab, 64 ref.

Descriptors: *Hydrologic data, *Surface waters, *Groundwater, *Available water, *Water quality, Runoff, Maps, Hydrogeology, Aquifer characteristics, Water wells, Well data, Water yields, Water levels, Groundwater recharge, Consumptive use, Water supply, Irrigation wells, Groundwater movement, Model studies, Chemical analysis, *Beaver County(Utah).

Beaver Valley, which includes 534 square miles in southwestern Utah, is in the Basin and Range physiographic province. The water needs of the valley are supplied mainly by four streams rising in the Tushar Mountains, which had a mean annual inflow of 56,020 acre-feet during 1966-74, and by withdrawals from wells during the same period, which averaged 5,080 acre-feet. The total amount of water in storage in the principal ground-water reservoir in the spring of 1974 was 12 million acre-feet. The dissolved-solids concentration of water from streams, springs, and wells in most parts of the valley is less than 500 milligrams per liter. Generally, the best quality surface and ground water is at the eastern side of the valley, and the poorest quality water is at the lower southwestern part. (Woodard-USGS) W79-07945

8. ENGINEERING WORKS

8A. Structures

SINGLE-VALVE PROTOTYPE TESTS, MAIN LOCK, LOCKS AND DAM 26, MISSISSIPPI RIVER, ALTON, ILLINOIS.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
D. E. Hart.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A06 1174. Price codes: A03 in paper copy, A01 in microfiche. Miscellaneous Paper H-78-10, September 1978. 29 p, 3 tab, 2 photos, 6 pl.

Descriptors: *Locks, *Valves, *Prototype tests, *Lock and Dam No. 26, Mississippi River.

Prototype tests were conducted to determine the fastest permissible single-valve lock chamber filling (and emptying) that could be tolerated without exceeding the generally accepted maximum load per hawser of 5 tons. A number of filling valve openings were used while hawser loads and other phenomena were measured. As a result, initial filling valve opening of 3.4 ft (20 sec) was recommended. No restrictions on the emptying valve opening were found to be necessary. (WES) W79-07530

OPTIMAL DESIGN OF CULVERTS UNDER UNCERTAINTIES.
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E. W79-07549

ARSENIC IN STREAMS, STREAM SEDIMENTS, AND GROUND WATER, FAIRBANKS AREA, ALASKA.
Alaska Univ., Fairbanks. Inst. of Water Resources.
For primary bibliographic entry see Field 5B. W79-07563

SEDIMENT TRAPS IN CHANNELS—DESIGN PROCEDURES AND PERFORMANCE.
Soil Conservation Service, East Lansing, MI.
For primary bibliographic entry see Field 21. W79-07804

WATER RESOURCES PLANNING, MANAGEMENT, AND DEVELOPMENT: WHAT ARE THE NATION'S WATER SUPPLY PROBLEMS AND ISSUES.
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 6E. W79-07882

WATER QUALITY CONTROL AND BLOOMINGTON LAKE.
Corps of Engineers, Baltimore, MD. Baltimore District.
F. B. Juble.
In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978. p 114-118, 5 fig, 7 ref. Interstate Commission on the Potomac River Basin, Rockville, Md. Technical Publication 78-2.

Descriptors: *Water quality control, *Dam sites, *Artificial lakes, *Earth dams, Impoundments, Flood control, River basin development, Mine drainage, Acid mine water, Alkalinity, Acidity, Acid streams, Engineering structures, Mathematical models, Stratification, Lakes, North Branch Potomac River(Maryland), Savage River(Maryland), Bloomington Lake(Maryland), Spillways.

The Bloomington Lake project, authorized by the Flood Control Act of October 1962, will be operated as a two-lake system to provide flood control, water supply, water quality, and recreational benefits. The Bloomington dam, currently under construction, will have an intake tower to control the emergency spillway flow into the outlet tunnel. The highly acid water of the North Branch Potomac River will affect the water quality of the lake which is estimated to range between pH 3.7 and pH 4.2 with an associated net alkalinity of -40 to -15 mg/l. Presently the river quality fluctuates, and during low flow periods a 2.7 pH with an associated net alkalinity of -180 mg/l has been measured. The function of the selective withdrawal intake tower is described and illustrated by schematic drawings. Mathematical modeling techniques were applied to determine lake stratification regarding temperature and acid quality, and to determine water withdrawal from the ports on the intake tower. Both models were linked and run simultaneously at various elevations to determine the optimum number and configuration of the ports. Regulation of Bloomington Lake will be geared to maintaining the best possible long-term water quality in the river downstream of the Savage River confluence. It will be necessary to maintain a constantly updated inventory of the acid stored in the lake and monitor the water quality at each level in the lake. An alkalinity inventory and quality profile will be kept for Savage River Lake, because Savage River is mildly alkaline. The water quality downstream should become constant when the system commences. (Davison-IPA) W79-07979

8B. Hydraulics

AN ESTIMATE OF CHANNEL ROUGHNESS OF INTEROCEANIC CANALS.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
G. H. Keulegan.
Available from the National Technical Information

Field 8—ENGINEERING WORKS

Group 8B—Hydraulics

Service, Springfield, VA 22161 as AD-A058 706. Price codes: A03 in paper copy, A01 in microfiche. Technical Report H-78-13, July 1978. 124 p, 39 fig, 23 tab, 40 ref.

Descriptors: *Canal construction, *Canals, *Roughness(Hydraulic), *Interoceanic canals.

The hydraulic roughness of the interoceanic canals created by either nuclear or conventional construction is considered. In the canals of nuclear excavation, the part of resistance due to the ejecta is estimated on the basis of distribution of size of ejecta material; and the part due to the expansions and contractions in the canal created by the explosives is attributed to the isostatic losses from free turbulence. For the conventional canals charged with very fine sediment, the friction of the granular surfaces is assumed to be that in a hydrodynamically smooth surface. In the presence of bed features, the added form resistance is estimated from the findings of Alam and Kennedy concerning alluvial rivers. A detailed study of resistance noted in Fort Collins tests shows that there is a difference in the frictional processes between the laboratory flumes and the natural rivers, suggesting that for resistance estimates reliance should be placed on river calibration. (WES)

W79-07529

SIDE WEIR IN RECTANGULAR CHANNEL, Roorkee Univ. (India). Dept. of Civil Engineering. K. G. Ranga Raju, B. Prasad, and S. K. Gupta. Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY5, Proceedings Paper 14596, p 547-554, May 1979. 6 fig, 1 tab, 8 ref, 2 append.

Descriptors: *Weirs, *Subcritical flow, *Laboratory tests, *Hydraulic models, Data processing, Irrigation, Sewers, Channels, Flow, Energy, Hydraulics, Side weirs, Broad-crested weirs, Sharp-crested weirs.

The discharge characteristics of a side weir at the head of a branch channel taking off at right angles to the main channel were investigated. Both sharp-crested and broad-crested weirs were studied for the case of subcritical flow in the main channel. A procedure of design based on De Marchi's theory was evolved. The De Marchi coefficient is empirically related to the Froude number at the upstream end of the weir, and the ratio of the upstream depth (above the weir crest) is related to the length of the weir. (Sims-ISWS)

W79-07534

TWO-DIMENSIONAL FLOW FIELD OF MULTIPORT DIFFUSER, Georgia Inst. of Tech., Atlanta. Dept. of Civil Engineering. P. J. W. Roberts. Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY5, Technical Note, p 607-611, May 1979. 3 fig, 5 ref, 1 append.

Descriptors: *Outfall sewers, *Flow characteristics, *Hydraulic structures, *Diffusion, Oceans, Hydraulics, Outlets, Shallow water, Analytical techniques, Laboratory tests, Jets, Flow, Dimensional analysis, Distribution patterns, Multiport diffuser, Plumes, Buoyant jets.

The two-dimensional flow field in the center of a long, multiport ocean sewage outfall diffuser was considered. The gross properties of the flow are predicted by simple dimensional arguments, assuming that the diffuser is approximated by a line source of buoyancy flux only, i.e., a pure plume. The results of two-dimensional experiments were presented. For fairly small times, the thickness of the surface layer is constant and independent of the source buoyancy flux. The surface layer occupies about 30% of the water depth, and advances, due to a balance of pressure and inertia forces, at a constant speed. For long times, the spreading of the surface layer is governed by a balance of pressure and interfacial shear forces. The thickness of the wastefield then grows slowly with time, and the length grows as the $4/5$ power of time. Comparison

of the results with those of the initial spreading phase of larger scale experiments on model multiport sewage outfall diffusers showed close agreement. (Humphreys-ISWS)

W79-07535

L.N. FAN'S DATA ON BUOYANT JETS IN CROSSFLOW, McGill Univ. (Montreal). Dept. of Civil Engineering and Applied Mechanics. V. H. Chu. Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY5, Technical Note, p 612-617, May 1979. 4 fig, 7 ref, 1 append.

Descriptors: *Jets, *Flow characteristics, *Diffusion, Hydraulics, Laboratory tests, Open channel flow, Analytical technique, Analysis, Spatial distribution, Discharge(Water), Buoyant jets, Cross-flow.

The experimental data by F.L. Fan on buoyant jet in a crossflow was successfully correlated and presented in a rather simple manner in this paper, using a set of dimensionless variables suggested by a line impulse model. There have been other more sophisticated analytical models developed in recent years, but the advantage of the simple model lies in the fact that experimental results can be correlated by simple formulas which can be used readily by practicing engineers. It also provides a better basis for further study on related problems with more complex initial conditions. It is important to point out that in the limiting case when the crossflow is very small, the simple formulas presented in this paper are not applicable in the region close to the exit. Wright has recently proposed a method to deal with the problem in such a limiting case. (See also W69-08423 and W77-09013) (Humphreys-ISWS)

W79-07536

OPTIMAL DESIGN OF CULVERTS UNDER UNCERTAINTIES, Texas Univ. at Austin. Dept. of Civil Engineering. For primary bibliographic entry see Field 2E.

W79-07549

FLOW CHARACTERISTICS IN TWO-DIMENSIONAL EXPANSIONS, S. V. Regional Coll. of Engineering and Technology, Surat (India). Dept. of Civil Engineering. For primary bibliographic entry see Field 2E.

W79-07551

WATER TEMPERATURE EFFECTS ON HORIZONTAL BUOYANT SUBMERGED JETS, West Virginia Univ., Morgantown. Dept. of Mechanical Engineering and Mechanics. J. B. Riestler, R. A. Bajura, and S. H. Schwartz. Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 293. Price codes: A08 in paper copy, A01 in microfiche. Research Report No. 4, September 1977. 144 p, 59 fig, 1 tab, 23 ref, 3 append. OWRT C-7171 (No. 6214) (1), 14-34-0001-6214.

Descriptors: *Pumped storage, Hydraulic models, Turbulence, Mixing, Froude number, Tailrace, Reservoirs, *Stratification, Reynolds number, Jets, Reservoir operation, Buoyancy.

Experimental and analytical studies were performed on submerged buoyant fresh water and salt water jets ejected horizontally into calm ambient water. The behavior of fresh water jets was found to be dependent upon the jet and ambient water temperatures as well as the Froude number and Reynolds number. As the ambient temperature was lowered, the jets penetrated to a greater horizontal. The jet width, centerline velocity, and centerline temperature also changed with ambient temperature. The jet trajectory was also shown to change with jet temperature. The trajectory of salt water jets was found to change with salt concentration in the jet. As salt concentration was lowered, the jets penetrated to a greater horizontal distance for the same Froude number. Results are

presented for various ambient and jet temperatures, and concentration levels for salt water jets. The results may be used in predicting trajectories, velocities, temperatures, and widths of fresh water jets, and trajectories of salt water jets. The nozzle geometry was shown experimentally to have a small effect on the jet trajectory. The turbulent mixing in fresh water jets was found to be independent of Reynolds number above a Reynolds number of 1550. The results of the nozzle geometry and Reynolds number studies are useful in formulating model studies.

W79-07572

MIXING IN RECTANGULAR TANKS USING HORIZONTAL JETS, West Virginia Univ., Morgantown. Dept. of Mechanical Engineering and Mechanics. D. L. Taylor, S. H. Schwartz, and R. A. Bajura. Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 298. Price codes: A07 in paper copy, A01 in microfiche. Research Report No. 5, October 1977. 115 p, 34 fig, 4 tab, 19 ref, 3 append. OWRT C-7171 (No. 6214) (2), 14-34-0001-6214.

Descriptors: *Pumped storage, Hydraulic models, Turbulence, Mixing, Froude number, Tailrace, Reservoirs, *Stratification, Reynolds number, Jets, Reservoir operation, Buoyancy.

The objectives were to determine the factors which affect the degree of thermal mixing that occurs when two rectangular tanks exchange water in a cyclical manner. The experiment tests were conducted with two types of initial conditions - (1) both tanks initially at a uniformly mixed temperature, and, (2) a two layer stratification profile in one tank with the thermocline located at the jet outlet. The independent test parameters were represented in nondimensional form by the Froude number, the Fourier number, and the number of cycles of operation. A stratification parameter, S , based on the center of gravity of the buoyancy of the water in the tank, was developed. For each of the initial conditions tested, a general correlation for the stratification parameter as a function of the dimensionless parameters was found. The functional relationship was based on the assumption that the amount of mixing that occurs within the tank is proportional to the volume of fluid entrained by the jet and the initial Froude number of the test. If the fluid is injected into a uniformly mixed tank, the stratification in the tank will be increased and then eventually decrease to the uniformly mixed state. A fluid jet injected at the thermocline of a strongly stratified tank will cause the stratification in the tank to decrease and eventually approach the uniformly mixed state. The destratification rate of a tank was found to be a function of the Froude number, the Fourier number, and the number of cycles of operation.

W79-07573

A NUMERICAL SIMULATION FOR A PUMPED STORAGE RESERVOIR, West Virginia Univ., Morgantown. Dept. of Mechanical Engineering and Mechanics. J. D. Faber, R. A. Bajura, and S. H. Schwartz. Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 290. Price codes: A08 in paper copy, A01 in microfiche. Research Report No. 7, October 1977. 153 p, 83 fig, 4 tab, 15 ref, 4 append. OWRT C-7171 (No. 6214) (3), 14-34-0001-6214.

Descriptors: *Pumped storage, Hydraulic models, Turbulence, Mixing, Froude number, Tailrace, Reservoirs, *Stratification, Reynolds number, Jets, *Reservoir operation, Buoyancy, Numerical analysis.

A computer program was developed to numerically simulate the velocity and temperature fields in an idealized two-dimensional pumped storage reservoir. The reservoir model includes a submerged inlet and a rising upper boundary to simulate rising water surfaces due to inflow. The solution is obtained by solving the energy, vorticity, and stream function equations using various finite differencing techniques. The eddy viscosity and eddy conduc-

tivity terms are constant. The numerical results were found to be in good agreement with analytical results. Reservoir operation was simulated with volume added and removed at 15% added, and 10% removed, and 21.6% agreement with analytical results.

W79-07574

EFFECT OF INITIAL TEMPERATURE ON THE THERMAL-HYDRAULIC BEHAVIOR OF WEST VIRGINIA NUCLEAR POWER PLANT, West Virginia Univ., Morgantown. Dept. of Mechanical Engineering and Mechanics. D. P. Michel, S. H. Schwartz. Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 299. Price codes: A07 in paper copy, A01 in microfiche. Research Report No. 6, October 1977. 115 p, 34 fig, 12 tab, 19 ref, 3 append. OWRT C-7171 (No. 6214) (4), 14-34-0001-6214.

Descriptors: Turbulence, Mixing, Froude number, Tailrace, Reservoirs, *Stratification, Reynolds number, Jets, Reservoir operation, Buoyancy.

The objectives were to determine the factors which affect the degree of thermal mixing that occurs when two rectangular tanks exchange water in a cyclical manner. The experiment tests were conducted with two types of initial conditions - (1) both tanks initially at a uniformly mixed temperature, and, (2) a two layer stratification profile in one tank with the thermocline located at the jet outlet. The independent test parameters were represented in nondimensional form by the Froude number, the Fourier number, and the number of cycles of operation. A stratification parameter, S , based on the center of gravity of the buoyancy of the water in the tank, was developed. For each of the initial conditions tested, a general correlation for the stratification parameter as a function of the dimensionless parameters was found. The functional relationship was based on the assumption that the amount of mixing that occurs within the tank is proportional to the volume of fluid entrained by the jet and the initial Froude number of the test. If the fluid is injected into a uniformly mixed tank, the stratification in the tank will be increased and then eventually decrease to the uniformly mixed state. A fluid jet injected at the thermocline of a strongly stratified tank will cause the stratification in the tank to decrease and eventually approach the uniformly mixed state. The destratification rate of a tank was found to be a function of the Froude number, the Fourier number, and the number of cycles of operation.

W79-07575

PUMPED STORAGE RESERVOIR, West Virginia Univ., Morgantown. Dept. of Mechanical Engineering and Mechanics. J. D. Faber, R. A. Bajura, and S. H. Schwartz. Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 290. Price codes: A08 in paper copy, A01 in microfiche. Research Report No. 7, October 1977. 153 p, 83 fig, 4 tab, 15 ref, 4 append. OWRT C-7171 (No. 6214) (3), 14-34-0001-6214.

Descriptors: Turbulence, Mixing, Froude number, Tailrace, Reservoirs, *Stratification, Reynolds number, Jets, Reservoir operation, Buoyancy, Numerical analysis.

This report describes a computer program developed to numerically simulate the velocity and temperature fields in an idealized two-dimensional pumped storage reservoir. The reservoir model includes a submerged inlet and a rising upper boundary to simulate rising water surfaces due to inflow. The solution is obtained by solving the energy, vorticity, and stream function equations using various finite differencing techniques. The eddy viscosity and eddy conduc-

Materials—Group 8G

activity terms in the equations were considered constant. The nodal spacing and the time step used were found to be the major parameters affecting stability. Results were obtained for a series of test cases with different percentages of the initial volume added. Cases were run for 0% of the initial volume added (or a constant surface level), for 15% added, and for 30% added. For each percentage of volume increase, Froude numbers of 3.16, 10, and 21.6 were run. The results are in qualitative agreement with experimental predictions for flow fields.

W79-07574

EFFECT OF VERTICAL SCALE DISTORTION ON THE TEMPERATURE FIELD OF A THERMAL-HYDRAULIC MODEL

West Virginia Univ., Morgantown. Dept. of Mechanical Engineering and Mechanics.

D. P. Michelotti, R. A. Bajura, and S. H. Schwartz.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 274. Price codes: A07 in paper copy, A01 in microfiche. Research Report No. 9, October 1978. 115 p, 34 fig, 12 tab, 11 ref, 2 append. OWRT C-7171 (No. 6214) (4), 14-34-0001-6214.

Descriptors: *Pumped storage, Hydraulic models, Turbulence, Mixing, Froude number, Tailrace, Reservoirs, *Stratification, Reynolds number, Jets, Reservoir operation, Buoyancy.

The objectives were to determine the effects of a vertical scale distortion on the flow and temperature fields of a hydraulic model of a pumped storage reservoir system. The study considered vertical to horizontal scale ratios of 1:1, 3:1, and 5:1. The model consisted of a submerged hot water jet discharging into an initially cold isothermal reservoir. The jet discharge geometry was patterned after what was considered to be a typical pumped storage outlet. Results are presented for various jet Froude numbers. Thermal mixing was demonstrated to be a function of the jet Froude number and the model distortion factor. A stratification parameter and an energy distribution parameter were developed to describe the characteristics of the reservoir in terms of the vertical temperature distribution. Temperature data for each experiment were correlated as a function of the Froude number, the distortion factor and the stratification and energy distribution parameters. Reservoir stratification was found to decrease as the jet Froude number is increased. It was also found that less thermal stratification occurred as the model distortion factor is increased.

W79-07575

PUMPED STORAGE SURVEY

West Virginia Univ., Morgantown. Dept. of Mechanical Engineering and Mechanics.

J. B. Riestler, S. H. Schwartz, and R. A. Bajura.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-297 329. Price codes: A03 in paper copy, A01 in microfiche. Research Report No. 3, September 1976. 43 p, 31 fig, 3 append. OWRT C-7171 (6214) (6), 14-34-0001-6214.

Descriptors: *Pumped storage, Hydraulic models, Turbulence, Mixing, Froude number, Tailrace, Reservoirs, *Stratification, Reynolds number, Jets, Reservoir operation, Buoyancy, Hydraulic structures.

This report presents a summary of data obtained from a survey sent to over 50 power companies concerning the operation and planning of pumped storage hydroelectric generating stations. The data were organized into the three categories of power output, geometric characteristics of sites, and operational considerations. Much of the data are presented in the form of histograms to summarize the statistical results into subcategories of interest. The information contained in this survey will be used to aid in the process of selecting reservoir models for study under the West Virginia University Pumped Storage Model Study program.

W79-07576

PERMEABLE WALL EFFECTS ON POISEUILLE FLOW

Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.

For primary bibliographic entry see Field 2E. W79-07749

8C. Hydraulic Machinery

BIT MAINTENANCE

Ingersoll-Rand Co., Phillipsburg, NJ.

G. Doyle.

Water Well Journal, Vol. 33, No. 6, p 47-49, June, 1979.

Descriptors: *Drilling equipment, *Maintenance, *Drill bits, Drilling, Rocks, Abrasion drill bits, Air-percussion drilling.

Tungsten carbide button bits are used effectively for percussion drilling in medium and hard rock formations. They are not self-sharpening and need periodic maintenance to maximize bit life and penetration rates. The bits are designed for efficient rock breakage and hole cleaning if used properly. Several rules for efficient percussion drilling are given. Frequency of bit reconditioning depends on drilling conditions. In hard-abrasive rock, a flat spot on a button should be immediately ground to a spherical shape. In soft or hard non-abrasive formations the buttons should be ground before reaching 10% expected bit life, even if no flat spots are visible. Bit maintenance also requires grinding the air blowholes and chip clearance grooves, greasing the threaded joint, and checking the body, splines, and striking end. Grinding requires a vitrified silicon carbide wheel one to two inches in diameter and an inch wide, rated at 24,000 rpm or more. (Purdin-NWWA)

W79-07509

GROUND WATER HEAT PUMP UPDATE

National Water Well Association, Worthington, OH.

D. Bacon.

Water Well Journal, Vol. 33, No. 6, p 44, June, 1979.

Descriptors: *Heat pumps, *Research and development, Laboratory tests, Projects, Heating, Cooling, Efficiencies, Discharge(Water), Groundwater.

Examples of residential developments incorporating ground water geothermal heat pumps are given. The heat pump's high operating efficiency gives these homes a distinct marketing advantage over homes with conventional heating and cooling systems. The Department of Energy has contracted with the National Water Well Association to investigate the hydrologic characteristics, costs, and environmental and legal aspects of heat pump use. George Smith, Inc. has begun a project to evaluate the efficiency of ground water geothermal heat pumps under controlled laboratory conditions. (Purdin-NWWA)

W79-07640

HACKMATAK MADE RELIABLE HAND PUMPS

Canadian Water Well, Vol. 5, No. 2, p 6, May, 1979.

Descriptors: *Pumps, *Hand pumps, *Appropriate technology, *Lumber, Conifer trees, Fabrication, Water wells.

The technique of fabricating wooden hand pumps is described in detail. It involves boring one or more logs to be used as casing. Many types of wood can be used, but the best is from a conifer called Hackmatack. A lathe is used to shape the spout and plunger. After turning, the plunger is cut to form a flexible joint with the plunger rod and the valve and pump leather are attached. The pump leather makes a seal between the plunger and cylinder walls. The valve, also of leather, is tacked to the top side of the plunger to provide a seal when the plunger is raised (thus causing the vacuum which raises the water), and opening on

the downward stroke to fill the upper casing with water. These pumps are capable of drawing water from 20 feet below the surface. (Purdin-NWWA)

W79-07723

WATER SYSTEM BASICS - TROUBLESHOOTING FOR JET PUMPS

Ground Water Age, Vol. 13, No. 9, p 13-15, 50, May, 1979. 5 tab.

Descriptors: *Jet pumps, *Pump testing, Charts, Maintenance, Repairing.

Troubleshooting charts for jet pump installation are presented in an easy to follow format. Five major problems are covered in five separate charts. These are: (1) the pump doesn't start or keep running; (2) the motor overheats and overload trips out; (3) the pump starts and stops too often; (4) the pump operates but delivers little or no water; and (5) the pump doesn't shut off. Several causes of each problem are listed along with techniques for checking and testing and procedures for correcting the problem once the cause has been determined. The charts are arranged in sequence so that the easiest checks are made first. In only a few cases is it necessary to pull the piping ejector or foot valve from the well. Most of the work can be done at the surface. (Purdin-NWWA)

W79-07738

8F. Concrete

LINER MATERIALS EXPOSED TO HAZARDOUS AND TOXIC SLUDGES

Matrecon, Inc., Oakland, CA.

For primary bibliographic entry see Field 8G. W79-07779

8G. Materials

BIT MAINTENANCE

Ingersoll-Rand Co., Phillipsburg, NJ.

For primary bibliographic entry see Field 8C. W79-07509

LINER MATERIALS EXPOSED TO HAZARDOUS AND TOXIC SLUDGES

Matrecon, Inc., Oakland, CA.

H. E. Haxo, R. S. Haxo, and R. M. White.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-271 013. Price codes: A04 in paper copy, A01 in microfiche. Report EPA-600/2-77-081, 1977. 62 p, 16 fig, 16 tab, 59 ref, 3 append.

Descriptors: *Linings, *Chemical wastes, *Waste disposal, *Durability, *Elastomers, Polymers, Oily water, Acids, Alkalies, Plastics, Pesticides, Oil wastes, Membranes, Concretes, Cements, Engineering structures, Waste water disposal, Industrial wastes, Sludge disposal.

The effectiveness and durability of various liner materials were examined for the interception and control of leachate from hazardous and solid wastes disposal sites. The materials evaluated as possible liners included: a native soil, modified bentonite, a soil cement, a hydraulic asphalt concrete, an asphaltic membrane, and 8 polymeric membranes based on polyvinyl chloride, chlorinated polyethylene, chlorosulfonated polyethylene, ethylene propylene rubber, neoprene, butyl rubber, an elastomeric polyolefin, and a thermoplastic polyester elastomer. The potential liner materials were exposed to the hazardous wastes, a strong acid, a strong base, oil refinery tank bottom waste, a combination of lead wastes from gasoline production, saturated and unsaturated hydrocarbon oil waste, and a pesticide. Preliminary results of the study indicated that some of the liner materials were not compatible with certain wastes and several combinations were eliminated, such as asphalt materials with oily wastes. Oily wastes were not compatible with noncrystalline polymeric membranes. Strong acids, bases, and concentrated brines adversely affected bentonite liners, polymer modified bentonite, and some soils. Aqueous wastes containing oily

phases posed the problem of the liners simultaneously resisting two components which were inherently different in their compatibility with materials. (Lisk-FRC)
W79-07779

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

GROUND WATER HEAT PUMP UPDATE,
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 8C.
W79-07640

RESEARCH OF THE U. S. FISH AND WILDLIFE SERVICE,
Fish and Wildlife Service, Washington, DC. Div. of Population Ecology Research.
J. A. McCann.
In: The Freshwater Potomac, Aquatic Communities and Environmental Stresses, Proceedings of a Symposium, January 1977, College Park, Maryland, Flynn, K. C. and Mason, W. T., Eds., 1978. p. 97-101. Interstate Commission on the Potomac River Basin, Rockville, Md. Technical Publication 78-2.

Descriptors: *Laboratories, *Research and development, *Wildlife, *Fish conservation, Pesticide toxicity, Fish reproduction, Fish conservation, Fish diets, Spawning, Fish behavior, Limnology, Fish diseases, Aquatic habitats, Aquatic environment, Toxins.

The activities of some of the fishery-oriented laboratories within the U. S. Fish and Wildlife Service which may be of particular interest to the Potomac basin are discussed. Work at the Fish Pesticide Research Laboratory, Columbia, Missouri, is concentrated on toxicological appraisal of the short- and long-term effects of pesticides and phthalate esters on reproduction, growth, and survival of fish and other aquatic organisms. The internationally known Patuxent Wildlife Research Center, Laurel, Maryland, conducts studies on contaminants in the Potomac River-Chesapeake Bay system focusing on critical problems of endangered species and migratory birds. The ecology of the Great Lakes is evaluated at the Great Lakes Fishery Laboratory, Ann Arbor, Michigan, where research on resource assessment, population ecology, fish psychology, and limnology is conducted. Research on restoration of the Atlantic salmon to its historic spawning grounds is carried out at the University of Maine, Orono. At the Eastern Fish Disease Laboratory, Leetown, West Virginia, studies of the diseases of sport and commercial fish are conducted. Cooperative Fishery Research Units, established at 25 major universities throughout the country, conduct coordinated cooperative research, and provide fishery resources related advance training programs. During the past decade fisheries Federal aid program has funded \$67 million for fisheries and environmental research and general studies. (Davison-IPA)
W79-07976

9D. Grants, Contracts, and Research Act Allotments

FEDERAL WATER POLLUTION CONTROL ACT CONSTRUCTION GRANTS,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 6E.
W79-07884

10. SCIENTIFIC AND TECHNICAL INFORMATION

10A. Acquisition And Processing

THE NATIONAL WATER DATA STORAGE AND RETRIEVAL SYSTEM (WATSTORE) OF THE U.S. GEOLOGICAL SURVEY,
Geological Survey, Reston, VA. Water Resources Div.
C. R. Shoven.
Paper presented at First NAWDEX Membership Conference, Denver, Colorado, May 9-11, 1978. 7 p. 1 fig.

Descriptors: *Data storage and retrieval, *Computers, *Information exchange, *Hydrologic data, *Data processing, Automation, Information retrieval, *National Water Data Storage and Retrieval System(WATSTORE).

As a part of the Geological Survey's program of releasing water data to the public, a large-scale computerized system, the National Water Data Storage and Retrieval System (WATSTORE) was developed. The WATSTORE system provides for the processing, storage, and retrieval of water data pertaining to surface water, quality of water, and ground water. At present (1978), there are 60 Geological Survey remote job entry sites, located in various offices throughout the country, that are equipped with high-speed computer terminals for remote access to the system. There are 36 terminals located in other Federal agencies and 13 terminals located in non-Federal governmental agencies that have access to the system. The primary use of the system by these agencies is to retrieve raw data for further analyses or to use the Geological Survey data files and computer programs to provide standard analytical results. (Woodard-USGS)
W79-07952

10C. Secondary Publication And Distribution

BIBLIOGRAPHIC SOURCES OF COMPUTER PROGRAMS AND NUMERICAL MODELS IN HYDRAULICS,
Geological Survey, Reston, VA. Water Resources Div.
C. Lai.
American Society of Civil Engineers, Hydraulics Division, Task Committee on Computational Hydraulics, August 1978. 13 p, 9 ref.

Descriptors: *Bibliographies, *Computer programs, *Mathematical models, *Hydraulics, *Indexing, Hydrology, Surface waters, Groundwater, Thermal water, Estuaries, Documentation.

In the fall of 1977, the Hydraulics Division of the American Society of Civil Engineers organized a new committee called 'Task Committee on Computational Hydraulics'. As one of its duties, the Committee at its first official meeting, held at the National Center of the U.S. Geological Survey on October 28, 1977, looked into the availability of mathematical, numerical and computer models for general use by hydraulic engineers. Many organizations and individuals have responded to the calls of the Task Committee to compile a list of bibliographies on computer programs and numerical models in hydraulics. This list has been prepared largely based on such responses and contributions. Part I contains sources that are in a form of formal publication and can be quoted by a proper reference or identification. Part II is composed of ad hoc lists prepared for the request of the Task Committee or informal lists, each of which may have previously been made for various purposes. Several small lists, each containing only a few programs or models, are catalogued in Part III. In addition to those contained in Parts I, II, and III, there were some which the editor was unable to classify or include in the above three parts. These are placed in Part IV. (Woodard-USGS)

W79-07703

THE NORTH CAROLINA COASTAL ZONE AND ITS ENVIRONMENT, VOLUME II. A COMPILATION OF RESOURCE MATERIALS COVERING THE COASTAL PLAIN, ESTUARIES, AND OFFSHORE WATERS,
Available from the National Technical Information Service, Springfield, VA 22161 as DP-1423, Price codes: A09 in paper copy, A01 in microfiche. E. I. du Pont de Nemours and Company, Savannah River Laboratory, Aiken, South Carolina. Report DP-1423, November 1977. 389 p. DOE AT(07-2) 1.

Descriptors: *Bibliographies, *Southeast, North Carolina, Coastal plain, Estuaries, Continental shelf, Hydrology, Weather, Charts, Maps.

A compilation of 630 oceanographic resource materials covers the coastal zone and continental shelf of the southeast. Subjects included in the second volume are: (1) hydrology and groundwater, (2) oceanography, (3) weather and climate, (4) miscellaneous, and (5) charts, maps, and atlases. Indexes by author, geography, and subject are given along with a list of journal and serial publications cited. (Bollinger-Mass)
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W79-07919 5C
W79-07920 5C

ABSTRACT SOURCES

SOURCE	ACCESSION NUMBER	TOTAL
A. CENTERS OF COMPETENCE		
Colorado State University, Irrigation Return Flow Quality	W79-07564, 07793 07804, 07890 07892, 07935 07989	7
Cornell University, Policy Models for Water Resources Systems	W79-07561--07562 07996--08000	7
Franklin Institute (FIRL), Municipal and Industrial Wastewater Treatment Technology	W79-07590 07774--07792 07794--07803 07805--07873	99
Illinois State Water Survey, Hydrology	W79-07532--07560 07745--07757 07759--07760 07763--07769	51
National Water Well Association, Water Well Construction Technology	W79-07509, 07563 07631, 07640 07723, 07738 07758 07761--07762	9
University of Florida, Eastern U. S. Water Law	W79-07591 07874--07889 07891 07893--07914	40
B. STATE WATER RESOURCES RESEARCH INSTITUTES	W79-07565--07570 07578--07589 07714--07716	21
C. OTHER		
Army Engineer Waterways Experiment Station	W79-07520--07531	12

ABSTRACT SOURCES

SOURCE	ACCESSION NUMBER	TOTAL
C. OTHER (CONTINUED)		
Environmental Information Services, Inc. (Effects of Pollutants on Aquatic Life)	W79-07592--07630 07632--07639 07641--07694	101
Information Planning Associates, Inc.	W79-07501--07508 07510--07519 07770--07773 07955--07988 07990--07995	62
Ocean Engineering Information Service (Outer Continental Shelf)	W79-07915--07934	20
Office of Water Research and Technology	W79-07571--07577	7
U. S. Geological Survey	W79-07695--07713 07936--07954	38
University of Massachusetts (Wetlands)	W79-07717--07722 07724--07737 07739--07744	26

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